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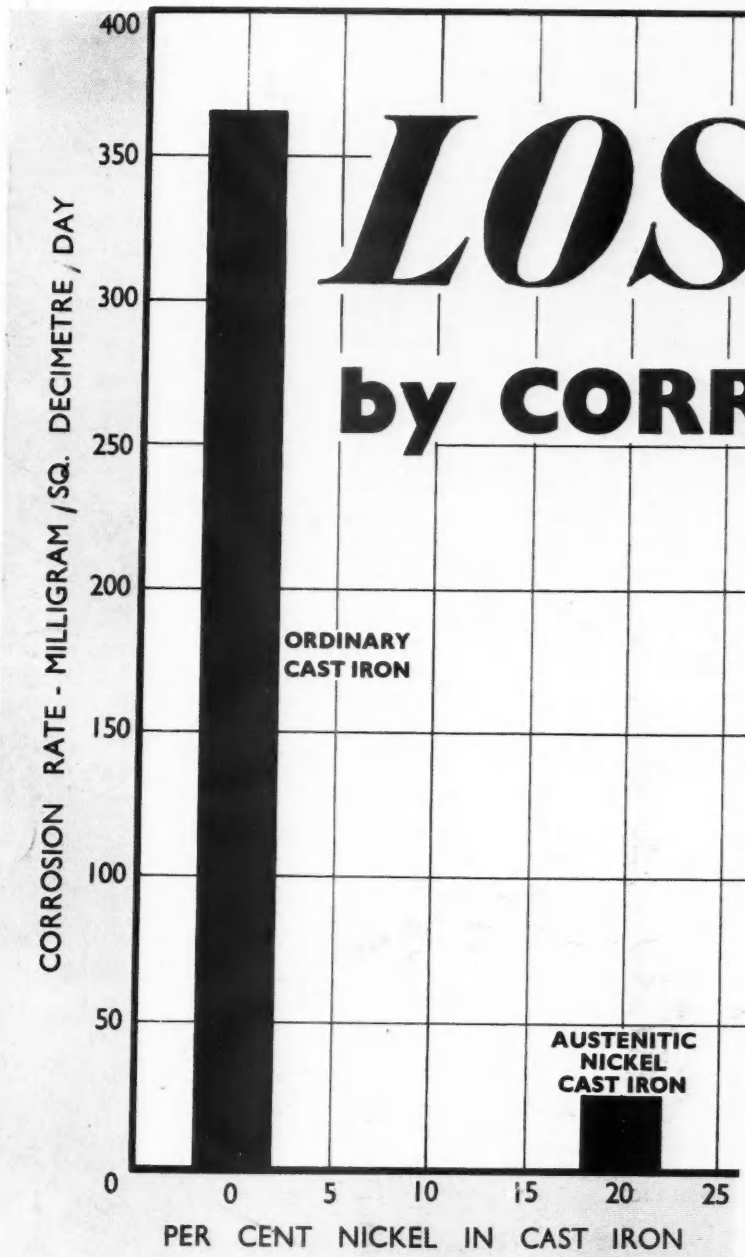

CORROSION TEST IN EVAPORATOR CONCENTRATING CAUSTIC FROM 100° TO 130° TW

EFFECT OF NICKEL ADDITION

LOSS by CORROSION

IN the laboratory, loss by corrosion is measured in terms of milligrammes per square decimetre per day. All small items—but in the world outside they represent many pounds per annum.

The diagram shows that striking economies may be made by changing from ordinary cast iron to an austenitic nickel cast iron and though the figures apply only to boiling caustic they are proportionately just as great with many other corrosive agents such as sea water, sulphuric acid or sewage.

This iron is inexpensive and easy to cast; it is also tough, strong and machinable. It is therefore suitable for valves, impellers, pump casings, pump bodies and a wide variety of other components.

Full details are given in our free publication B9, "Austenitic Cast Irons," and B14, "The Manufacture and Physical Properties of Nickel-Copper-Chromium Austenitic Cast Iron."

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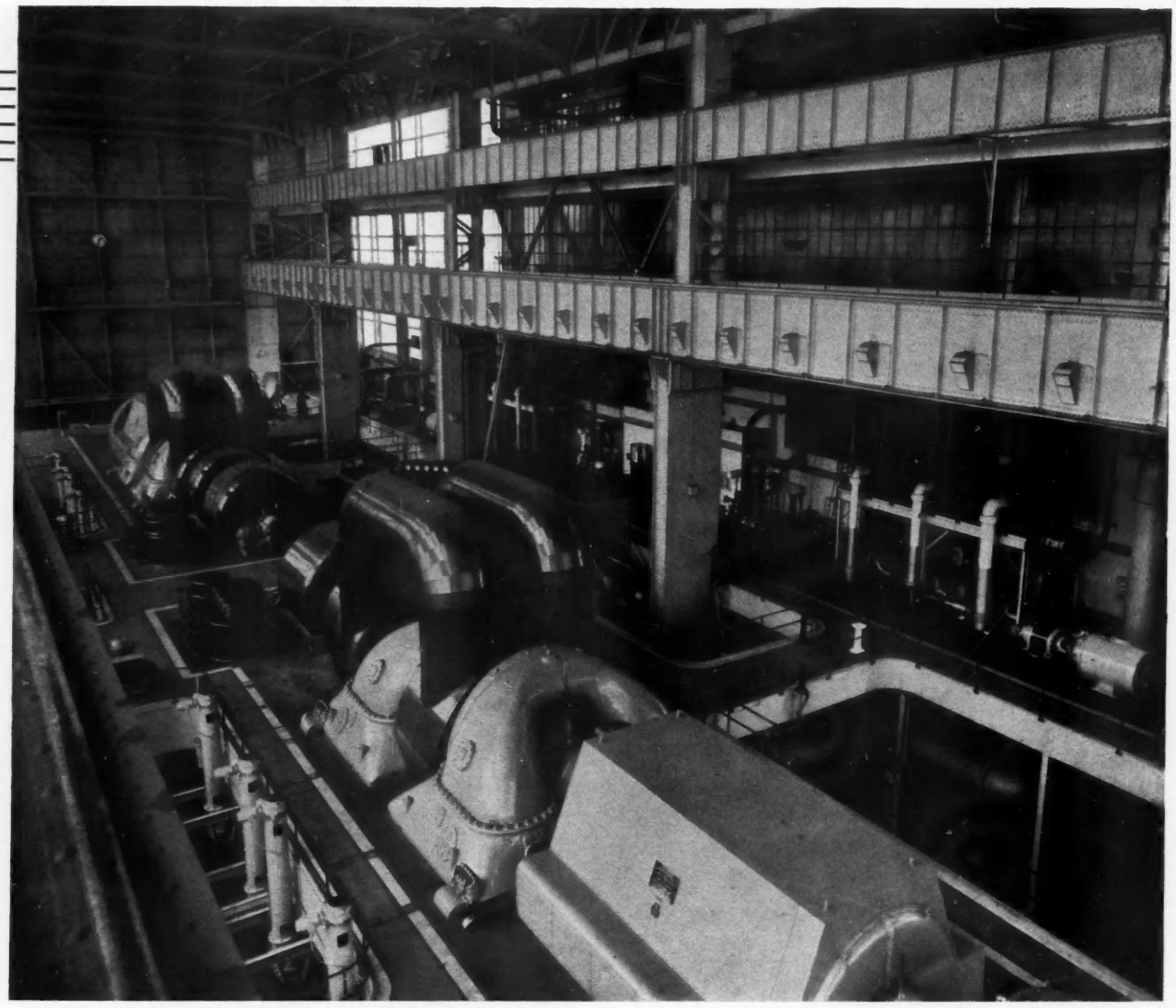

Another great Power Station fitted with AITON PIPES

The picture shows the Turbine Room of the
BARKING "B" POWER STATION
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COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD.

ALL HIGH PRESSURE PIPES SUPPLIED AND ERECTED BY AITON.

OPERATING STEAM CONDITIONS, 625 lbs. per square inch, 840° Fahrenheit.

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PIPES

A Seven-Day Journal

The Birthday Honours.

FROM the official list of Honours, conferred by the King on the occasion of His Majesty's birthday on June 3rd and in commemoration of the completion of the twenty-fifth year of His Majesty's reign, we take the following names:—Sir Arthur Balfour and Sir George May become Barons; while among the new Baronets are Sir R. Burton Chadwyck, Sir Henry Jackson, and Mr. Evan Williams. Knighthoods have been conferred upon Mr. Noel Ashbridge, Chief Engineer of the British Broadcasting Corporation; Mr. H. H. Humphries, M. Inst. C.E., the City Engineer of Birmingham; Mr. G. A. Mitchell, M.I. Mech. E.; Dr. S. L. Pearce, Engineer-in-Chief of the London Power Company; and Mr. Arthur Pugh. Sir Frederick Gowland Hopkins, President of the Royal Society, receives the Order of Merit. In the Order of the Bath Engineer Rear-Admiral H. H. Little, and Lieut.-General Sir H. J. Elles (Master-General of the Ordnance) become K.C.B.; and Mr. H. E. Wimperis, Director of Research at the Air Ministry, a C.B. The C.B. is also awarded to Dr. F. S. Sinnat, Director of Fuel Research. In the Order of the British Empire, Engineer Rear-Admiral Robert Beeman becomes K.B.E., and Engineer-Captain Dight, C.B.E. The C.B.E. has also been conferred upon Mr. F. W. A. Handman, resident engineer for the Lower Zambesi Bridge; Colonel William Burden, M.I. Mech. E., Chief Superintendent, Research Department, Royal Arsenal; Colonel J. Mills, M.I. Mech. E., late Assistant Director of Ordnance Services; and Group Captain C. G. Smith, M.I. Mech. E., of the Royal Air Force. Among the Civil awards Mr. Walter Citrine becomes K.B.E., and Professor Alfred Fowler (of the Imperial College), Mr. G. E. W. Humphrey (managing director of Imperial Airways), and Mr. L. G. S. Stanley (Assistant Secretary of the Air Ministry) receive the C.B.E. We are pleased to note that the O.B.E. has been given to Mr. Andrew Cockburn, who served on the "Lusitania" and was late chief engineer on the "Mauretania."

Banquet to Colonel Crompton.

IN our last week's issue of the "Seven-Day Journal," we announced that a banquet would be held at the Savoy Hotel on Friday, May 31st, to celebrate the ninetieth birthday of Colonel R. E. B. Crompton. The Chairman at that banquet, Sir Arthur Stanley, announced the reception of 160 congratulatory telegrams, and, amongst others, read two, one from the Duke of Connaught, who had served under Colonel Crompton as a junior subaltern, and one from the Headmaster of Harrow, where Colonel Crompton was educated seventy-five years ago. In proposing the toast of "A Pioneer," Sir James Swinburne pointed out that, starting life as a soldier, Colonel Crompton had been a pioneer not of one, but of several branches of engineering. In India circumstances had led him to be the pioneer of road transport when he developed a steam tractor more than twenty years before its introduction here. In civil life he had led the electrical industry out of its scientific infancy into the practical business methods which started it on its successful career, many of the measuring devices used to-day owing their introduction to him. The Colonel replied in a short written speech, and it was notable that it was delivered with the voice and manner of a young man. As already announced, Colonel Crompton was presented with the portrait of himself by Harcourt, which hangs in the Academy, and at once gave it to the Institution of Electrical Engineers. Professor W. N. Thornton, in acknowledging the gift on behalf of the Institution, regretted that the picture could not be shown at that dinner, but felt sure that many present had already seen it. Mr. R. E. L. Maunsell, Vice-President of the Institution of Mechanical Engineers, then presented Colonel Crompton with the Certificate of Honorary Life Membership of the Institution. A very successful and enjoyable evening was brought to an end with speeches by Mr. G. Balfour and Sir John Snell on the "Electrical Future," and by Professor Sir J. A. Fleming on "Our Chairman and Hosts," to which Sir Arthur Stanley, an admirable Chairman, responded.

Waterloo Bridge.

IN the House of Commons on Monday evening, June 3rd, the second reading of the London County Council's (Money) Bill was taken. In opening the debate, Mr. Hore-Belisha, Minister of Transport, said that whatever decision the House might wish to reach on the question of the financial method of meeting the cost of dismantling Waterloo Bridge which had been incurred, and particularly on the proposal to allow the London County Council now to borrow, on which point the Government had no desire to stand in the Council's way, there could no longer be any question of a grant from national funds in aid of the expenditure which the Council had decided to incur on their own motion and contrary to the wishes of Parliament. After the Bill had been read a second time, Sir W. Davison moved an instruction to the Committee which would consider the Bill to leave out Paragraph (C) of Item 9 of Part I of the Schedule in which the London County Council asked Parliament to give it power to raise by loan during the year ending March 31st, 1936, £140,260, and during the half-year ending September 30th, 1936, a further £140,000, making a total during the two periods mentioned of £280,260. This money was required, it was stated, to meet part of the cost of demolishing the old Waterloo Bridge and constructing a new one at an estimated figure of £1,295,000. After a vigorous discussion, the motion for the Instruction to the Committee as above stated was carried by 121 votes to 96, a majority of 25. In the course of the debate, Mr. W. S. Morrison said that it would be better, from the financial point of view, for the County Council to pay for the bridge by the proceeds of a penny rate for five years, than to pay interest charges for an accommodation for a period of years which the Council did not require, and which to it was a mere luxury.

The Institute of Welding.

IN the course of his presidential address at the Institute of Welding at the twelfth annual meeting of the Institute, which rook place at the Institution of Mechanical Engineers on Monday, June 3rd, Sir Alexander Gibb referred to the great extension of fusion welding, and the important part which it had already taken in engineering constructional activities, and to its many-sided applications in both the ferrous and non-ferrous metal industries. There was, he said, a deeply felt need for a strong central organisation to which all welding interests could look for guidance. Sir Alexander announced that the two British organisations for dealing with welding, namely, the Institution of Welding Engineers and the British Advisory Welding Council, more recently founded, had decided early this year to consider the reorganisation of their respective constitutions and programmes of work in order to keep pace with the rapid progress of the application of welding. A scheme for the amalgamation of the two bodies was found to be practicable and desirable. As a result the Institution of Welding Engineers had now revised its constitution and changed its name to the Institute of Welding, in order to enable it to cover the functions of both organisations, to undertake a wider and more comprehensive programme of work, and to meet the pressing demands of all branches of engineering for guidance. There were already, Sir Alexander said, about 800 individual members of the Institute. Sir James Lithgow, Sir William Larke, and Mr. Ralph Freeman have accepted the positions of Vice-Presidents, and Mr. R. Biggart, Mr. Laurence Ennis, and Dr. McCance have agreed to serve as councillors representing the industrial corporate membership class. The retiring President, Mr. C. W. Hill, will be available to assist in the administration.

British Industries Fair.

AT the close of the British Industries Fair at Castle Bromwich on Friday, May 31st, it was announced that it was intended to develop the exhibition on Empire lines. No decision has yet been made in the matter of the date of the next Fair, and whether the later date will be still adopted, or whether the Fair will again be held at the same time as the London section, has yet to be fixed. Many exhibitors have, we understand, already booked space for next year, and in a number of instances have decided to extend their stands. In the Heavy Engineering Section good business was done with Empire and Scandinavian countries. Some of the best business in the Fair was recorded on the sales of excavators and contracting plant, which were exhibited in the outdoor section. The electrical industry did good business, especially in its domestic and lighter sections, which were visited by many buyers from the Scandinavian countries. Valuable inquiries were also received by the heavy branches of that industry. The exhibitors in the Hardware and the Building and Heating Sections of the Fair have expressed themselves as generally satisfied with the business which was done, and the inquiries made, which came, we understand, both from overseas and home buyers. The total attendance figures, including the buyers from home and overseas, amounted to 115,828, or somewhat less than the figure of 124,178 for last year.

The Unemployment Figures.

ACCORDING to a statement issued by the Ministry of Labour on Monday, June 3rd, there were approximately 10,334,000 insured persons in employment. This was 14,000 more than on April 15th, and 141,000 more than a year ago. Further improvement between April 15th and May 20th in most of the principal industries was recorded. Those in which the improvement was most marked were building and public works contracting, general engineering, the cotton, hosiery, and tailoring industries, the distributive trades, and hotel and boarding-house service. There was a large increase in the numbers temporarily stopped in the coal-mining industry, mainly in Yorkshire and the Midlands, and a decline in employment in the motor vehicle industry, in steel melting, rolling, &c., and in textile bleaching, dyeing, and finishing. The numbers of unemployed on the registers of employment exchanges on May 20th totalled 2,044,752. This was 292 more than on April 15th, but 45,629 less than a year before. The total number of boys and girls on the registers increased by 10,300 between April 15th and May 20th, owing to the registration of juveniles who left school at Easter. During the five weeks ended May 20th, the number of vacant situations notified by employers to the employment exchanges and juvenile employment bureaux was 267,792, while the number filled was 232,786.

Hours and Wages in Industry.

A PRELIMINARY conference of the shipbuilding employers and the shipyard trade unions took place in Edinburgh on Friday, May 31st, in order to survey the position of the industry with regard to the desire of the unions that consideration should be given at an early date to an increase in wages. After statements on both sides had been heard and considered, the trade unions intimated their inability to abandon their claims and they made a formal application for an advance of 2d. per hour to time workers and an equivalent advance to pieceworkers. A conference for the consideration of the claim is to be arranged. Speaking at the annual conference of the National Committee of the Amalgamated Engineering Union at Llandudno, on Monday, June 3rd, Mr. J. C. Little, in his presidential address, said that every month saw additions to the firms which were reducing working hours without reducing wages. It was estimated that already some 700,000 workpeople were enjoying a shorter week without reduction in pay. He announced that the trade unions involved in the claims for a reduction of hours in the engineering industry from forty-seven to forty without reduction of pay were meeting in the second week in July in order to consider the next step to be taken with regard to hours, wages, and conditions in the industry.

Shipping and the Sugar Beet Subsidy.

THE Shipowners' Parliamentary Committee, which is fully representative of British shipping, has addressed to Mr. Walter Runciman, the President of the Board of Trade, a letter strongly urging the Government to discontinue State assistance to the beet sugar industry. After referring to the disabilities now being suffered by the shipping and shipbuilding industries, the docks and allied trades, the letter refers to the report of the recent Sugar Industry Inquiry Committee, and expresses the opinion that the carrying on of the industry with State assistance would stultify the broad policy of the Government placed before the World Monetary and Economic Conference of 1933, a policy already embodied in the Ottawa agreements. The letter goes on to point out that the artificial production of sugar in the United Kingdom necessarily excludes a corresponding import from overseas; the freight on the excluded imports is estimated at £350,000 per annum; imports to the value of the sugar produced in this country—say, £2,000,000—would purchase a corresponding export of goods or services; and the freight on purchases of goods to that amount would be, say, £200,000. After giving credit for the small gain in coastal freights, the minimum direct loss to shipping cannot be less than half a million pounds every year. These estimates are based on average production, prices, and freights for 1933 and 1934. The hope is expressed that these considerations will receive the earnest attention of the Government.

A New Atlantic Record.

THE French liner "Normandie," which left Le Havre on Wednesday evening, May 29th, on her maiden voyage to New York, broke all Atlantic records by making the run from Bishop Rock to the Ambrose Lightship in 4 days 3 hours 2 minutes. The average speed recorded was 29·98 knots, and it gains for France the coveted Blue Riband which previously had been held in turn by Great Britain, Germany, and Italy. The longest summer track was used, and another record was made in the average speed from Sunday to Monday, which was 31·55 knots. On Saturday, June 1st, the ship had to reduce her speed to about 28 knots for a period of nearly 11 hours, owing to a broken condenser tube, which necessitated shutting down one of the four turbo-alternator sets and standing off five boilers. It is expected that when the machinery has been run in and settled conditions have been reached even better speeds will be attained. During the past two months much work has had to be done in order to finish the ship in time for her scheduled sailing, and her fine performance on her maiden voyage reflects the greatest credit alike on her builders, her commander, and her engineering staff.

PUMPING PLANT AT KING GEORGE V DOCK, SOUTHAMPTON

(*For description see opposite page.*)

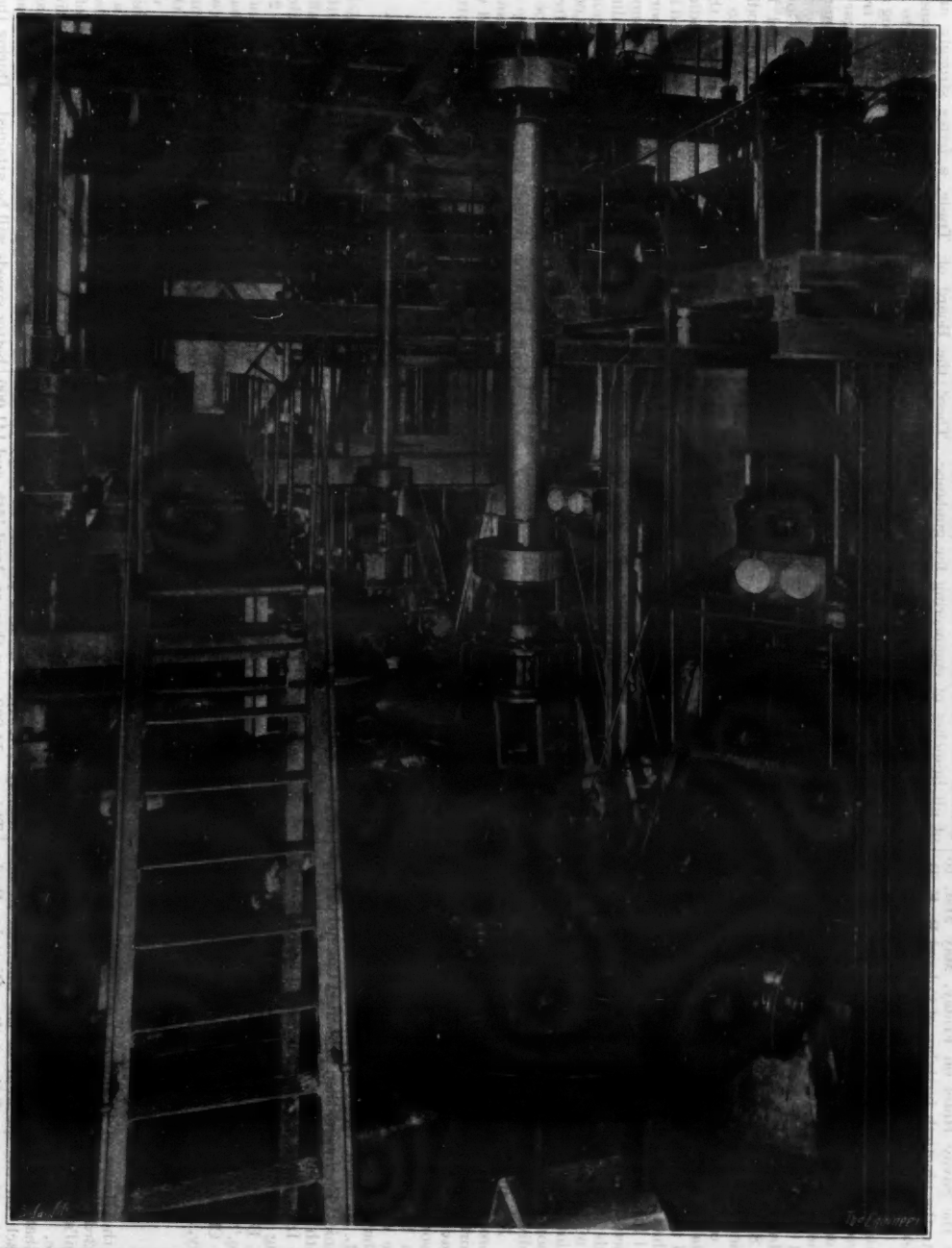


FIG. 1—PUMP CHAMBER

FIG. 2—VIEW SHOWING PRIMING EXHAUSTERS

King George V Graving Dock, Pumping Plant and Equipment.

No. I.

Pumping Plant.

THE pumping machinery and electrical equipment for King George V Graving Dock at Southampton represent the latest practice in this field and incorporate many novel features. The dock is the largest of its kind in the world. The overall length is 1200ft., the width of entrance 135ft., the depth from cope to floor 59½ft., and the quantity of water contained when filled to H.W.O.S.T. may be as much as 9,220,720 cubic feet. It is known as No. 7 Dock. In the future another dock may be constructed adjacent to it, and all the pumping machinery is designed with this in view, so that the plant already installed will be capable of being used on the second dock (No. 8).

The pumping equipment consists of four main pumps, "A," "B," "C," and "D.", three drainer pumps, "E," "F," and "G," and a number of auxiliaries. Besides its normal duty of dewatering No. 7 dock or the future dock No. 8 and impounding No. 7 dock or No. 8 dock for the purpose of raising the level of water inside above the river level, the plant is required to deal with storm water. The construction of the new docks extension and the graving dock necessitated the rearrangement of certain of the Southampton Corporation storm water outfalls. Under normal conditions the storm water flows by gravity into the river through non-return valves, but should heavy storms occur simultaneously with high tide in the river, pumping of this storm water has to be resorted to. For small flows the drainer pumps "E," "F," and "G" may be used, but under heavy storm conditions one or even two of the main pumps may have to be used.

It will be appreciated that in order to enable the pumps to accomplish these various duties a complicated system of culverts and sluice valves is involved. Fig. 3 shows diagrammatically the arrangement of the culverts, and Fig. 7 is from a photograph of a model, constructed in wood to a scale of ¼in. to 1ft., of the culverts, valves, and pumps, from which an idea of the complexity of the system will be gained.

The pump chamber itself is 110ft. in length by 25ft. in width and the main pump floor is 40ft. below coping level. The drainer pump chamber is situated 61ft. below coping level.

The general arrangement of the pumping machinery is shown on page 584.

Main Pumps "A," "B," "C," and "D."—The four main pumps "A," "B," "C," and "D" are of the Gwynne centrifugal vertical spindle double inlet type. They are connected on the inlet side to two separate suction chambers formed in the concrete foundations, pumps "A" and "B" to one sump and "C" and "D" to the other. These pumps have 54in. delivery and 60in. diameter suction branches and were specially designed to give satisfactory performance when dewatering and impounding and also when dealing with storm water. A section of the pumps is shown in Fig. 5.

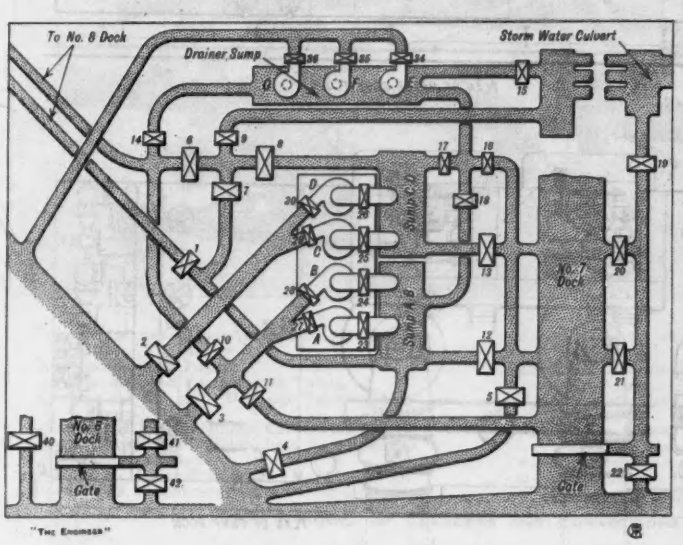


FIG. 3—ARRANGEMENT OF CULVERTS

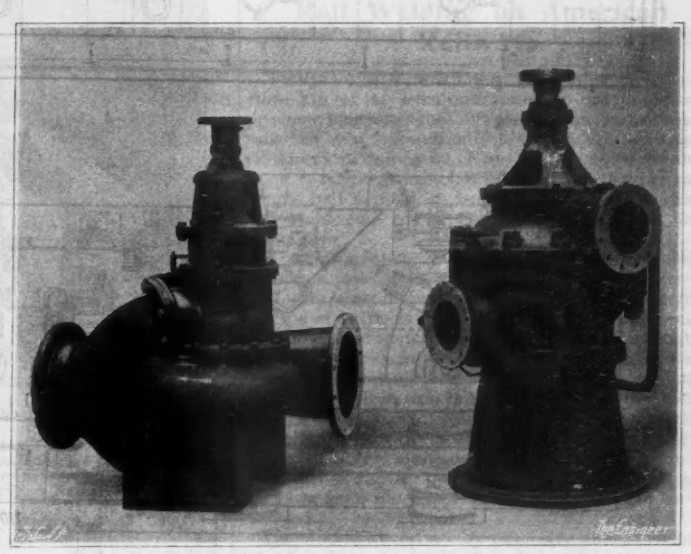


FIG. 4—BOOSTER AND FIRE PUMPS

The casings are of cast iron of sufficient strength to withstand the maximum pressure which can be imposed upon them under the worst conditions of operation, viz., with the suction connected to the river, the level of which would be at its maximum, and the pump running at full speed with the discharge valve closed. This pressure may rise to as high a figure as 100ft. of water. In order to be able to withstand these conditions the casings are each built of four parts, comprising the volute, the lower suction branch, and the upper suction branch divided into two to facilitate dismantling. By the adoption of this arrangement all parts under pressure are of simple and robust section, requiring no ribbing. In addition, to strengthen the volute itself, a number of cast iron streamline section cross stays are provided in the volute casting suitably reinforced with high-tensile steel bolts.

The impellers are of the turbine-bladed type, designed with self-regulating characteristics over the wide range of heads involved, a special feature being the absence of cavitation even with the high suction lifts imposed. They are made of a special nickel-iron alloy, selected to withstand the corrosive effect of the estuary water dealt with.

The shafts, which are of high-tensile steel, are enclosed in nickel-iron sleeves to prevent them from coming in contact with the water. The bearings of the pumps are lignum vitæ, housed in zincless bronze casings. Renewable casing and impeller eye rings are provided, these also being of non-corrosive nickel-iron alloy.

The weight of the pump rotating parts and the intermediate shafting between the pumps and the motors is carried in an air-cooled Michell thrust bearing mounted in an arch bracket bolted on top of the pump casing. This incorporates, in addition, a Michell journal bearing. The intermediate shafting for each pump is steadied in two gun-metal lined plummer blocks supported on steel girders.

The vertical shafting connects to the motor shafts by means of Wellman Bibby couplings. Lubrication of the bearings is provided for by means of Tecalemit separate electrically driven grease pumps.

Performance.—The performance of these pumps on official trials is illustrated in Fig. 6. They were

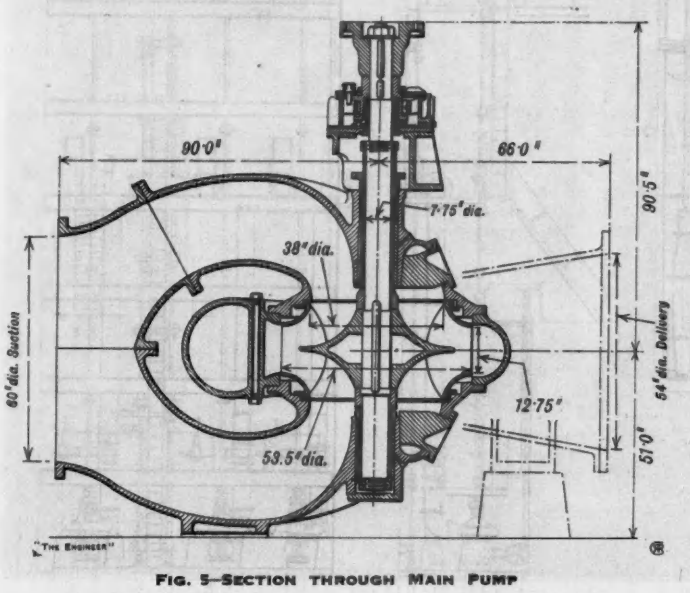


FIG. 5—SECTION THROUGH MAIN PUMP

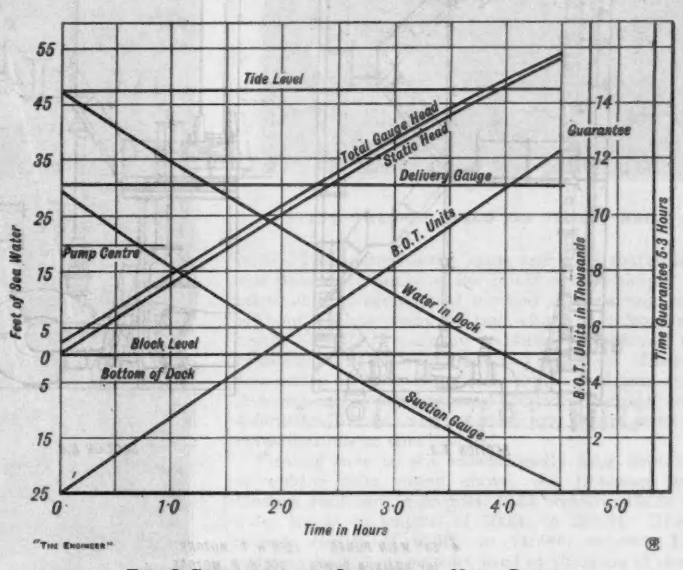


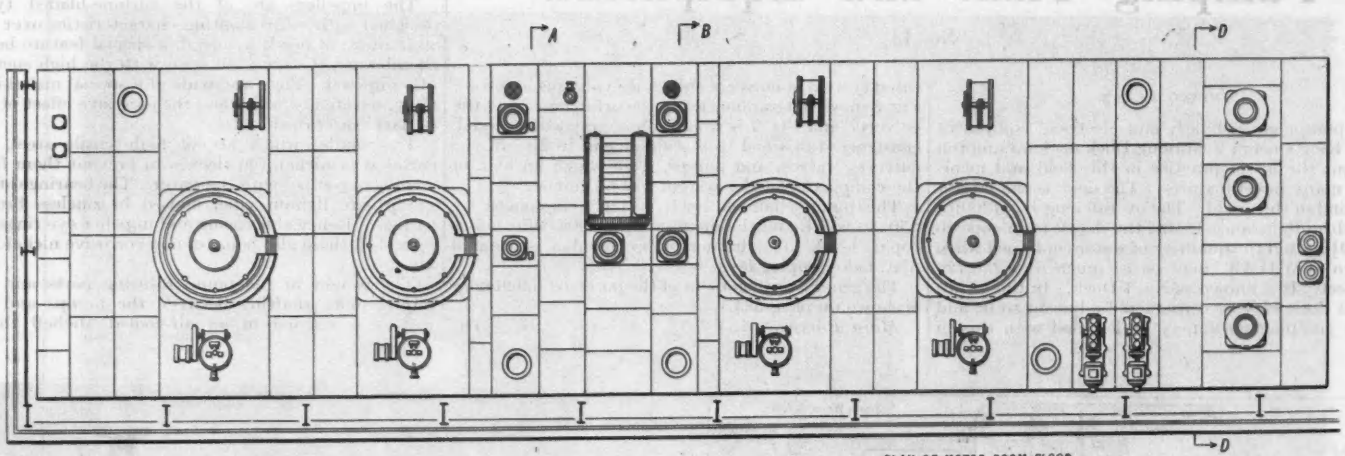
FIG. 6—PERFORMANCE CURVES OF MAIN PUMPS

Drainer Pumps "E," "F," and "G."—These pumps are of the single-inlet Gwynnes centrifugal vertical-spindle type, having 16in. delivery and 18in. suction branches, designed to deal with drainage water from the dock and having the impellers specially arranged to deal with storm water. They are capable of discharging

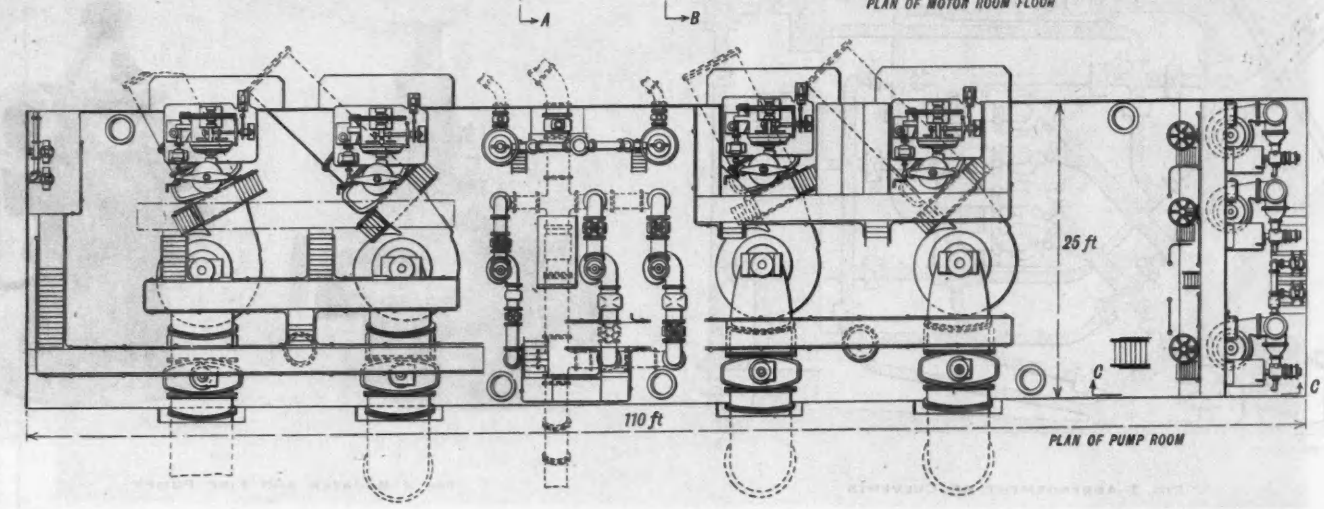
required to dewater the dock in 5·3 hours when three were working together under the worst tidal conditions. The guaranteed consumption of electricity was 13,224 B.O.T. units. It will be seen that the dock was actually dewatered in 4·5 hours, and that the current consumption was 12,230 B.O.T. units.

KING GEORGE V DOCK, SOUTHAMPTON, PUMPING PLANT

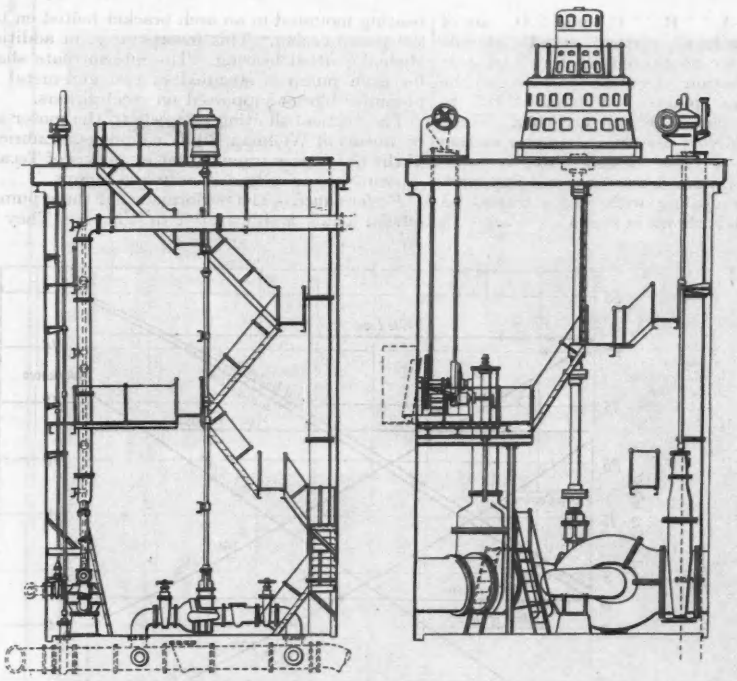
GWYNNES PUMPS, LTD., HAMMERSMITH, ENGINEERS



PLAN OF MOTOR ROOM FLOOR

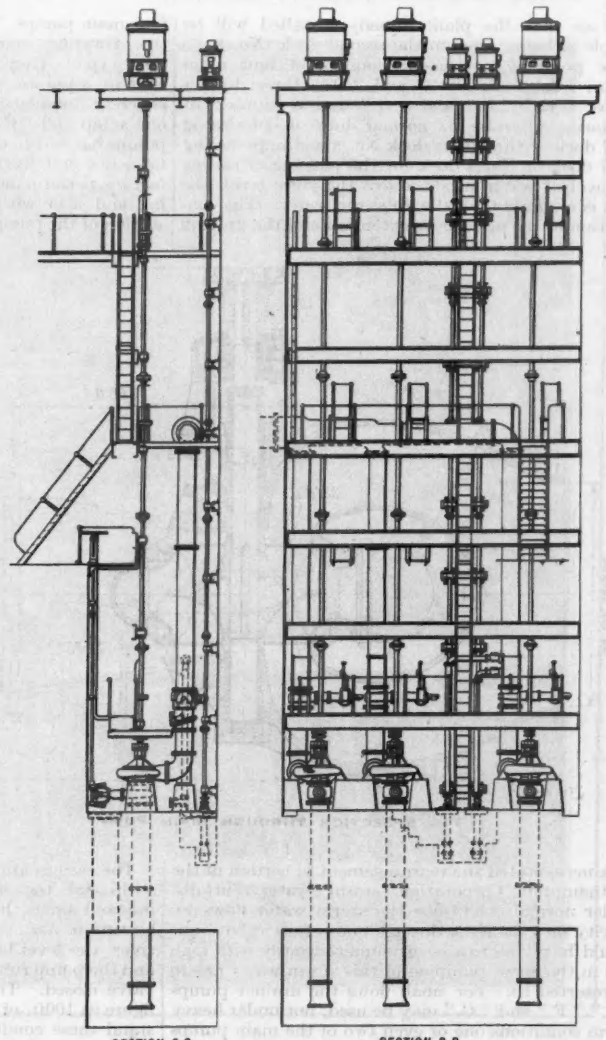


PLAN OF PUMP ROOM



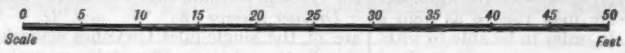
SECTION A.A.

SECTION B.B.



SECTION C.C. DRAINER PUMP PIT SECTION D.D.

4 54" MAIN PUMPS 1250 H. P. MOTORS
3 16" DRAINER PUMPS 200 H. P. MOTORS
2 16" CIRCULATING WATER PUMPS 32 H. P. MOTORS
1 10" CIRCULATING WATER PUMP 35 H. P. MOTOR
2 8" FIRE PUMPS 135 H. P. MOTORS
HOUSE SERVICE PUMPS, EXHAUSTERS ETC.

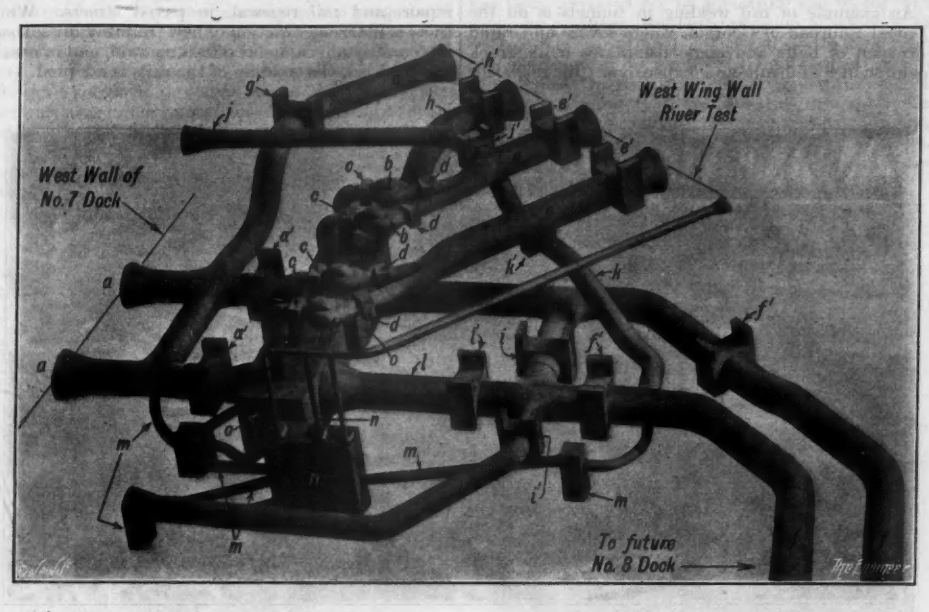


"THE ENGINEER"

charging 4900 gallons of sea water per minute against a total gauge head from all causes of 76ft., when running at a speed of 580 r.p.m. When dealing with storm water the head is much lower and the discharge consequently much greater. The materials employed are the same as those for the main pumps. They are driven by 200 b.h.p. slip-ring induction motors.

Fire Pumps "H" and "J."—For providing high-pressure water for fire-fighting on board a vessel in the dock, two 8in. two-stage Gwynnes centrifugal vertical-spindle pressure pumps are installed—see Fig. 4. They draw water from a suction sump connected to the river and situated beside the main pump chamber. The pumps are designed to deliver 500 tons of sea water per hour each, against a total gauge pressure of 120 lb. per square inch and are driven by 135 b.h.p., 1450 r.p.m. vertical-spindle slip-ring induction motors.

Circulating Water Pumps, "K," "L," and "M."—When certain large size vessels are docked, it is still afloat, the connection to the vessel, of course, being above sea level. When the dock has been dewatered, a second connection is made to the auxiliary circulating system on the ship below the water line. Under conditions of relatively high tide there is sufficient head to allow water to flow from the suction sump mentioned above through a 21in. pipe to the vessel, but under conditions of low tide it becomes necessary to boost the pressure so as to obtain sufficient circulating water.



g g'.—10ft. dia. Suction Culverts from No. 7 Dock, and Control Valves.
b.—54in. dia. Main Pumps.
c.—60in. dia. Main Pump Suction Valves.
d.—54in. dia. Automatic Discharge Valves on Main Pumps.
e e'.—10ft. dia. Pump Discharge Culverts and Valves.
f f'.—10ft. dia. Suction Culverts from No. 8 Dock and Control Valves.
g g'.—10ft. dia. Filling Culvert and Valve, No. 7 Dock.
h h'.—10ft. dia. Impounding Suction Culvert and Valve.
i i'.—10ft. and 6ft. 6in. dia. Storm Water Suctions and Valves.
j j'.—6ft. 6in. dia. Impounding Discharge and Valve, No. 7 Dock.
k k'.—6ft. 6in. dia. Impounding Discharge and Valve, No. 8 Dock.
l l'.—10ft. dia. Suction Culvert from No. 8 Dock and for Storm Water and Valves.
m.—36in. Drainage Suctions and Valves.
n.—Drainage Sump, Pumps and Discharge Culverts.
o.—Main Pump Sumps.

FIG. 7—MODEL OF CULVERTS AND CONNECTIONS

Two 16in. Gwynnes centrifugal low-pressure, vertical-spindle circulating pumps "L" and "M" have therefore been installed, one as a stand-by to the other. Each of these is capable of a throughput of 4200 gallons per minute, increasing the pressure by 14·5ft. These pumps run at 475 r.p.m., and are driven by 32 b.h.p. motors—see Fig. 4.

Auxiliary Pumps.—Additional auxiliary pumps are installed, comprising two 4in. house pumps for draining the pump chamber, two 2in. drainer pumps for discharging leakage water from the valve pits mentioned below (these being situated in the main pump chamber), and a further two similar valve pit drainer pumps in the opposite wall of the dock for the same purpose.

FIG. 8—ONE OF THE MAIN PUMPS

necessary to provide circulating water for the auxiliary condensers, not only during the docking period, but all the time the vessel is in dock. In order to accomplish this a 10in. Gwynnes vertical-spindle pump "K" is provided, capable of discharging 2100 gallons of sea water per minute against a total gauge head of 30ft., when driven by a 35 b.h.p. motor. This pump draws water from the same suction sump as the fire pumps, and is connected through piping to the auxiliary circulating pump on the ship while

Fig. 1 gives a general view of the pump chamber and Fig. 8 shows one of the main pumps. Fig 4 illustrates one of the booster pumps and one of the fire pumps before installation.

Priming System.—The centre line of the main pumps is 23·25ft. above the floor of the dock, and therefore should pumping operations cease for any reason when the water level in the dock is below the top of the pump casing, it may become necessary to prime the pumps by exhausting the air from the interior of the casings. For this purpose, two four-cylinder vertical type Gwynne exhausters have been provided, direct coupled to 30 b.h.p., 950 r.p.m., slip-ring induction motors. They are illustrated in Fig. 2. They are provided with interceptor tanks to prevent water reaching the exhausters. The piping connections are brought from the exhausters to duplicate sets of distributor valves mounted on the control platform so that the operator can prime any of the main pumps from this position. In a similar way duplicate distributors are installed adjacent to the drainer pump motors and controls, so that the pump attendant can prime any of the drainer pumps with either of the exhausters.

(To be continued.)

Rail Welding on American Railways.

THE practice of welding rails together in order to eliminate or at least minimise the rail joints and produce long stretches of continuous or unbroken rails has been followed only to a very limited extent on American railways. Even so, the use is notable, since it includes stretches of main line having rails nearly half a mile in length. And troubles from expansion and contraction movements have been negligible.

Apart from these few lengths of 500ft. to 2800ft., the main use of welding rails in the track is to eliminate joints in level crossings and in stations, giving lengths of 117ft. to 273ft. It is used in a few cases in tunnels and underground railways and for lengths of 400ft. to 500ft. in the car-retarder tracks of gravity switching or sorting yards. Gas, thermit, and electric welding are all in use, but the last-named only on a small scale as yet. Most of the very long stretches have been made by thermit welds. Gas welding is employed largely in the minor jobs, as the same equipment serves also for cutting up old rails and cutting the nuts from old track bolts where rails are to be renewed.

There is, however, a very extensive and increasing use of welding to build up worn and battered rail

FIG. 1—THERMIT WELD ON 130-LB. RAIL

ends. This improves the joints and track materially, but does not eliminate the joints and is simply an effective and economical method of repairing rails without the necessity of removing them from the track. Similar repair by welding is employed for frogs and switches—or points and crossings. The rail committee of the American Railway Engineering Association has the matter of welded rails under consideration, but has not yet made any report as to its investigations or conclusions.

Turning now to the exceptionally long stretches of welded rails, noted above, the Delaware and Hudson Railroad, in August, 1933, welded rails in its main tracks in lengths of 500ft. to 2800ft. These include curves of 950ft. to 1450ft. radius. The ordinary bolted joints were used at the ends of these welded sections. A view of one stretch of double line with welded rails is shown in Fig. 2. The railway company's office building appears at the left. In the thermit welded joint—Fig. 1—holes are drilled in the rail web on each side of the joint for the attachment of clamps described later. In Fig. 3 two joints in the right-hand track are ready for welding. At the left side of the view the apparatus is shown clearly. Above the rail is the little "cupola" for the fusion metal, with the mould below it for the fusion weld of the base, web, and lower part of the rail head. At the side are the powerful clamps to force the rail heads together longitudinally with sufficient pressure to ensure a complete butt weld of the heated rail heads.

In 311 welded joints only five failed, and none of them were in the longest sections. Of these five breaks, three occurred during extremely cold weather and were attributed to high stresses set up in the rails during the welding process. The other two were simply defective welds. These breaks were repaired temporarily by bolting on the ordinary angle fish-plates, and they were later eliminated by cutting out a 20ft. length of rail and welding a new piece in place at convenient times. There has been no further trouble. If breaks should occur they can be repaired promptly by bolting on fish-plates.

In May, 1934, this railway welded another lot of 250 joints, making four rails—in double track—each about 2000ft. long. No breaks or movements have occurred. The tracks are laid with 130-lb. flat-bottom rails of medium manganese steel, on double-shoulder tie plates or base plates. The ordinary dog spike rail fastenings are discarded in favour of a special fastening which consists of a spring clip bearing on the rail flange and bolted to a lug on the tie plate, this plate in turn being fastened to the creosoted tie or sleeper by screw spikes which do not grip the rail. The spring clips serve to prevent creeping of the rails.

These test sections of long welded rails are found to keep in much better surface and alignment than ordinary track, and what little maintenance work of this kind has been necessary has been no more difficult than on ordinary track, whether on straight or curved line.

It is considered that there is a marked improvement in the riding quality of track with welded rails, together with a definite saving in maintenance of locomotives and rolling stock, owing to the smoothness in riding. The atmospheric temperatures along this railway range from hot summer sun to sub-zero in winter. The welding was done under high summer temperatures, with the rails at 125 deg. to 130 deg. Fah.

Advantages claimed for the long rails by Mr. Clarke, engineer of maintenance of the railway, include the following :—(1) Savings in cost of maintenance of track, or permanent way ; (2) longer life of rails, owing to the elimination of worn and battered joints ; (3) labour saving in laying rails, owing to the longer life ; (4) better conductivity for track circuits ; (5) elimination of rail bonding at joints ; (6) saving in maintenance costs of locomotives and rolling stock ; (7) smoother riding track, owing to the absence of rail joints ; (8) saving in maintenance of alignment and surface, owing to the elimination of rail creeping.

All the welding on the Delaware and Hudson Railroad has been done by the thermit pressure-butt process. Electric welding of rails in the track has not been tried extensively, as it involves numerous difficulties. However, a machine has been perfected for making the electric "flash-weld" on rails in track, and this machine is to be put into service in a few months. This type of weld is considered to be one of the best yet developed, and it can be made quickly and economically.

FIG. 2—WELDED RAILS, DELAWARE AND HUDSON RAILROAD

In the pressure-butt welding process, there is a fusion weld of the base and web of the rails, while the heads are welded by pressure only, the metal of the heads being brought to welding temperature by means of the slag resulting from the thermit reaction. The moulds for the fusion weld are so designed that the slag completely surrounds the rail heads and brings them to a welding heat in a short time after the weld has been poured. Heavy clamps, already attached to the rails, are then drawn up, forcing the rail heads together under very high pressure, sufficient to make a thorough butt weld.

In view of the admitted disadvantages of the universal type of bolted and spliced—or fished—rail joint, the long and detailed studies of stresses in rails and joints, and the innumerable designs of rail joints aiming at minimising the disadvantages, it seems rather strange that the actual elimination of the joints has not made greater progress. However, present practical and economical methods of welding rails into continuous lengths are of relatively recent development. Some railway engineers predict a much greater use of this method in the next few years, although some also consider that it will be used mainly to produce lengths of 400ft. to 500ft. rather than for such lengths as 2000ft. to 2800ft. as employed on the Delaware and Hudson Railroad.

An example of rail welding in tunnels is on the Central Railroad of Georgia, where severe and rapid corrosion of bolts and angle fish-plates made track maintenance difficult and expensive. In 1930, the rails for two tunnels were welded into continuous lengths of 2450ft. and 1200ft. The 90 lb. flat-bottom rails were welded outside into lengths of 429ft.—or eleven 39ft. rails—and these were pulled into the tunnels by a locomotive, the final welds being then made with the rails in place. Joints at the ends of the welded lengths were made with the ordinary bolted angle fish-plates, with ¼in. expansion spacing ; but there has been practically no movement of the rails in these joints. In this instance all the welding was done by the oxy-acetylene process.

For subway or rapid-transit underground lines, welding the joints has an additional advantage in reducing the noise nuisance. On the other hand, the application of this method has difficulties on such lines, with their frequent train service and limited working space. At Boston, in 1932, a length of 10,500ft. of track in the Boylston-street subway had the rails welded into lengths of about 1000ft., with switch or point rails at the ends to allow for expansion and contraction movements.

Both the thermit process and the electric carbon-arc, seam-weld process were used. In the latter, the rails are not actually welded together, but fish-plates are welded to the heads and flanges of the rails. There were no failures of thermit welds, but two electric welds failed and a dozen showed signs of weakness. All these were repaired by welding, and there was no further trouble. At Philadelphia, a length of 1447ft. of track has been welded by the thermit process. Both of these underground lines are used only by electric tramway cars in passing through busy city districts.

On American street railways, or tramways, welded joints are in the great majority, mainly in paved streets, but also on open track. This includes both flat-bottom rails and grooved-head girder rails. It is estimated that 95 per cent. of the rail joints of such railways are welded—75 per cent. by the thermit process and 20 per cent. by the electric arc weld process. The acetylene gas process is used in a few cases. This practice of welding the joints not only makes an easier riding track, but greatly reduces the high cost of track maintenance and repair, and rail renewal, in paved streets. While there is little construction of new tramway lines, there is a considerable amount of rail renewal, and in nearly all this work the welding of the rails is adopted.

FIG. 3—WELDING RAIL JOINTS, DELAWARE AND HUDSON RAILROAD

For the thermit welding on these lines the process is rather different from that used in steam railway track, as the pressure-clamping apparatus cannot be applied to paved track. A loose insert of rail steel is placed between the rail ends. The flange or base, the web and part of the head of the rail, are fusion welded, while a fairly good butt weld is secured between the rail ends and the insert. This construction is of ample strength for such track and the loads which it carries, but would not be satisfactory for the heavier loads of ordinary railway service. A line in Vincennes-road, at Chicago, has welded rails for 1½ miles, the longest section between joints being 1700ft. This is double track, with 100 lb. flat-bottom rails. The principal maintenance is at the expansion joints, which are of the ordinary bolted type.

It has been estimated by the engineering section of the American Electric Railway Association that with a complete solution of the problem of welding joints which would add five years to the average life of street railway track, the annual saving to the industry would be some £3,000,000 in lessened depreciation, apart from the saving resulting from decreased maintenance. So important was this subject considered that a committee was organised to study it, the members representing the above Association, the American Welding Society, and the United States Bureau of Standards.

An elaborate programme of tests was carried out, six types of welded joints being subjected to tension, bending, drop, repeated impact, shear, conductivity, and telemeter or strain-gauge tests. The joints included bar weld, butt weld, cast weld, thermit weld, apex weld, and seam weld. Some of the joints had bolted or welded fish-plates. The rails were of the grooved-head girder type. No comparative conclusions were presented by this committee, but its final report, in 1932, described the various tests and their results.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

MULTI-TUBULAR HORIZONTAL BOILERS.

No. 609—1935. The second of the projected series of Specifications for Land Boilers has now been issued. This specification deals with horizontal multi-tubular boilers of dryback and waste-heat types, and is generally similar to the specification issued last year for Lancashire and Cornish boilers, but includes, in addition, appropriate provisions and rules for tubes and bar stays. The new specification exoludes setting, insulation and furnace fittings, mechanical stokers, air preheaters, and similar auxiliary gear which are to be the subject of mutual agreement. In the preparation of the specification representatives of the leading boiler insurance companies, marine classification societies, the Mercantile Marine Department of the Board of Trade, numerous boiler-makers and users, collaborated.

The British Industries Fair at Birmingham.

No. IV.

(*Continued from page 573, May 31st.*)

A. C. WICKMAN, LTD.

THE ordinary works depends for the accuracy of its productions on the accuracy of the gauges used by the workmen. If a fitting shop exists in which machines are built up from parts made in the machine shop, some inaccuracy of the gauges is perhaps allowable; but in the cases where mass-production methods are employed and there is no fitting as such, the accuracy of the gauges is of very great importance. It is, therefore, rather unfortunate that it is just in the mass-production factory that gauges are most likely to become inaccurate. They are in such frequent use that, in the past at least, it has been no unusual thing to find at the end of a single day's work that a plug gauge has worn so far as to be useless for its purpose. To meet such conditions A. C. Wickman, Ltd., of Coventry, have brought out a set of gauges

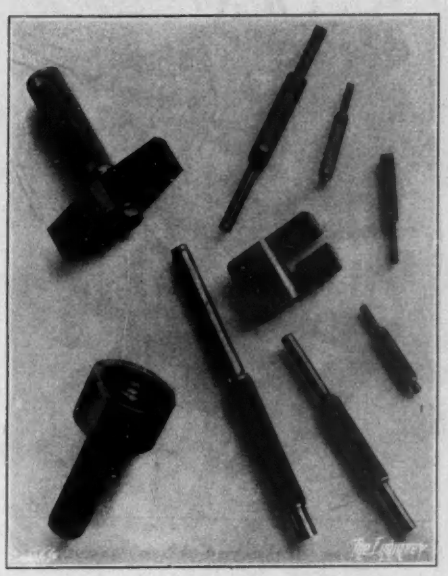


FIG. 38—WIMET-TIPPED GAUGES—WICKMAN

tipped with Wimet metal, some of which are shown in the engraving—Fig. 38. Up to the present the system has only been applied to small ring gauges, plug, and snap gauges. It is claimed for it that a very great increase of life is given to the gauge, especially when it is subjected to heavy frictional wear, and that in consequence of the sustained accuracy of the gauge, the possibility that parts, passed by its use in a worn condition may have subsequently to be rejected, is remote.

The Wimet-tipped gauges, having only recently been brought out, were undoubtedly the exhibits which attracted the most attention on the firm's stand. But we noticed also that Wimet-tipped milling cutters, twist drills, reamers, lathe tools, &c., were also exhibited, besides "Spedia" lapping wheels, which are used for the final lapping of Wimet hand cutting tools, gauges, and other metals, where an exceptionally fine finish is required.

MOSS GEAR COMPANY, LTD.

Owing to the irreversability of large reduction worm gearing, some degree of risk is attached to a drive of this nature in the event of a blockage occurring in the mechanism. In such an event damage occurs, since the drive does not stall, and even when prompt stopping of the machinery has saved actual damage it is necessary to dismantle the drive to remove the obstruction. This is particularly the case with mechanical stoker gear, which is always subject to jamming from clinker, large lumps of fuel, or heat strains. On the stand of the Moss Gear Company, Ltd., of Tyburn, Birmingham, a stoker drive mechanism for central heating furnaces was demonstrated, in which this danger has been carefully avoided in a simple yet efficient manner. In Fig. 40 it will be seen that a spring-operated dog clutch has been provided in the driven shaft line. This jumps out of engagement when the torque applied to it exceeds a certain value, to reingage only when the obstruction has cleared itself. An additional advantage of this clutch is that the drive can be readily disengaged when it is desired to move the feed mechanism by hand. The gear-box itself is a compact and robust job, and has a fan incorporated with it. Such practical details as lubrication points and filler and inspection doors are adequate. The mechanism itself is a neat adaptation of the epicyclic principle for the final reduction, which is itself driven by worm from the initial drive pulley. An electric motor drives the worm by vee belt, a drive which further protects the motor from harm. The tensioning of this belt has been provided for by mounting the motor on a swinging platform, the lower position of which is set by a screw adjustment. The pulleys in this drive can be changed to provide a final adjustment of gear ratio. On the other end of the worm shaft is mounted a vane type fan for the draught. The motor circuit provides different speeds. It also includes two thermostat switches, one for wall mounting and one for immersion in the heating water.

FIG. 39—STOKER DRIVE—MOSS GEAR

These provide completely automatic temperature control, as by cutting out the motor both fuel feed and draught are stopped. A view of this drive is shown in Fig. 39. In addition, the Moss Gear Company showed one of their well-known deep-well pump heads and a series of standard reduction gear sets. These are both single and double reduction types, and, we understand, are suitable for any type of motor. In addition there was shown one of the "Mechanics" universal joints. Designed primarily to overcome the weakness inherent in the design of the standard mechanical universal joint, in that the torque is taken by pins in shear, in the "Mechanics"

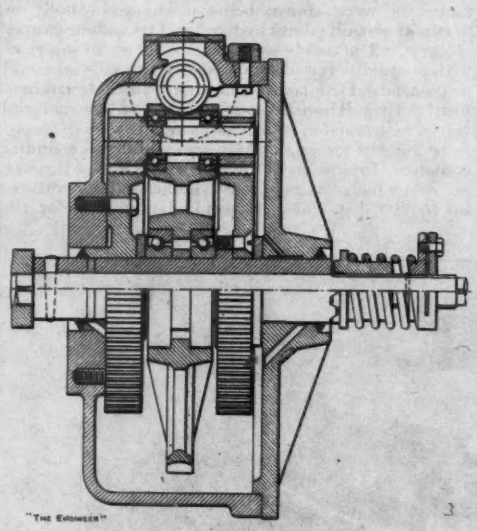


FIG. 40—STOKER DRIVE—MOSS GEAR

joint this is obviated by butting a turned female register on the yoke against a male member. The joint is equipped with needle roller bearings, and is totally enclosed. A large oil reservoir in the centre of the spider provides lubrication to all moving parts.

DESOUTTER BROTHERS, LTD.

So many and various were the exhibits of Desoutter Brothers, Ltd., of The Hyde, Hendon, London, N.W.9, that it is only with difficulty that we find it possible to make a choice as to which to describe. To mention all within such an article as this would be impossible. It is claimed that never before has so small a drill as the $\frac{1}{16}$in. rotor air drill been constructed with such power. The device weighs only 2½ lb. and has a pistol grip handle, as shown in Fig. 41. Its motor runs at 2100 r.p.m., with air at 80 lb. to 100 lb. per square inch. It is said that the design is such that the low efficiency and objectionable exhaust noises hitherto associated with this type of motor have been eliminated. The rotor, chuck spindle, and other important parts are made of nickel-chrome-molybdenum steel, heat treated for resistance to shock. All rotating parts are mounted in ball and roller bearings, and the chuck spindle is driven through roller bearing epicyclic reduction gearing. The air consumption is stated to be 11 cubic feet per minute.

The subject of the second illustration, Fig. 42, is the "Air Router" for the high-speed carving, drilling, and routing of wood. This tool is driven by an impulse reaction turbine running at 55,000 r.p.m.,

FIG. 41—AIR DRILL—DESOUTTER

and has a consumption of 6 cubic feet of free air per minute, delivered at a pressure of 100 lb. per square inch. The cutter head is mounted on a precision ground spindle running in ball bearings, and the balance is claimed to be so good that, even at 55,000 r.p.m., vibration is absent. A split chuck of $\frac{1}{4}$in. capacity is made integral with the spindle. As will be seen from the engraving, the cutter head is mounted in a conveniently shaped base, which incorporates the work follower. Fine adjustment for depth is effected by slackening a fly nut and screwing the head up or down, subsequently relocking the nut. Use is made of the exhaust air to blow the chips away. For carving the head can be mounted on suitable fixtures and by the use of several heads in this way multiple carving can be carried out from a master. The tool is capable of such work as rein line routing, grooving a small moulding on straight or curved work, hinge fitting, &c.

The firm does not specialise in air-driven tools. There were to be seen at the Exhibition a number of

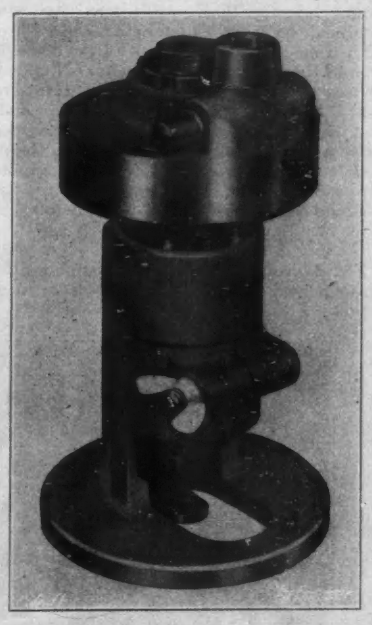


FIG. 42—AIR ROUTER—DESOUTTER

similar electrically driven tools, among which may be mentioned the new drill gun which, with a capacity of $\frac{1}{16}$in. in steel at a penetration of 3in. per minute, runs at 2500 r.p.m. and weighs only 2½ lb.

MOTOR RAIL, LTD.

The marshalling of goods arriving at the British Industries Fair by rail was undertaken not by the railway, but by Motor Rail, Ltd., of Simplex Works, Bedford, who provided a 65–85 h.p. oil-engined locomotive to carry out this work. The locomotive is suitable for works shunting. It combines an adequate adhesive weight of 20 tons, with a fuel consumption given as 0·41 pints per brake horse-power per hour.

The engine is a four-cylinder model of the airless injection type, fitted with Bosch fuel pumps. It

develops 65 b.h.p. at 1000 r.p.m., and 85 at 1500 r.p.m. The cylinders are 120 mm. bore by 180 mm. stroke. A "Comet" type detachable cylinder head carries the overhead valves, while the liners are also detachable. C.A.V. starting and lighting equipment is fitted, as well as Westinghouse air and standard hand brakes, these operating on all four wheels. The drive is through a single-plate clutch to the firm's two-speed gear-box, thence by roller chains to both axles.

The gear-box is of the "constant-mesh" type with a reverse allowing the use of both speeds in either direction. An adjustment of a simple quick-operating type is fitted to the final drive chains. The governing of the engine is automatic at idling speed and at 1500 r.p.m.; for intermediate engine speeds, a single lever control is used, the injection control being automatic. Axle-boxes are of the roller bearing type. The cooling radiator is of the shockproof type mounted sideways to be equally efficient in both directions; a water pump and fan are provided. The maximum tractive effort is given as 8593 lb. at 3·6 m.p.h. In addition to this locomotive the firm exhibited two 2ft. gauge locomotives. We illustrate one of these in Fig. 43. This is the 20–28 b.h.p. oil-engined model; the other is the 20–26 b.h.p. petrol engine model. Both are identical save in the engines fitted, and are simplified versions of the larger model. Plain bearings of the wick-lubricated type are fitted to the axle-boxes, while the power brake has been omitted. The electric equipment has also been removed as hand starting is quite easy on these engines. In the case of the oil-engined model the engine is a two-cylinder model of 115 mm. bore by 130 mm. stroke. Nitrided cast iron liners are fitted and detachable heads of the "Comet" type. C.A.V.-Bosch fuel pumps and A.C. oil and air cleaners are used; the governing is operative at idling and at 1800 r.p.m. In the petrol-engined model the two cylinders, of chromium cast iron, are of 120 mm. by 140 mm., with Ricardo detachable heads. Ignition is by magneto.

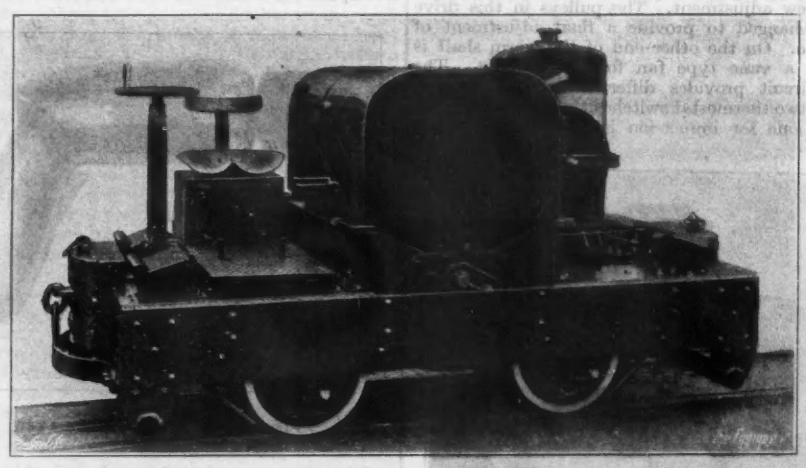


FIG. 43—TWO-FOOT GAUGE OIL LOCOMOTIVE—MOTOR RAIL

PNEULEC, LTD.

In Fig. 44 we illustrate a 6ft. mixing mill. This was prominent among the various foundry machines shown by Pneulec, Ltd., of Smethwick, Birmingham. The mill is of the stationary pan type, equipped with revolving runner and stirrers. Wear plates of $\frac{1}{2}$in. mild steel are provided. These are easily renewable, only the crib having to be unbolted and removed. Grease lubrication is fitted. A spring-tensioning device is fitted to the runner so that as the depth of material increases additional pressure is brought to bear on it. The stirrers are easily replaceable and can be varied in number to suit the working conditions. Three cast iron ploughs are fitted; the forged steel driving shafts are carried in ball and roller bearings. The mill is equipped with an initial reduction gear consisting of a paper pinion and cast iron spur wheel for direct motor drive. In this machine the use of positively driven stirrers, as well as the ploughs, prevents the sand becoming heavy or caking. The width of the runner and face are proportioned to give a twist action to the sand, which has been found to give the most intimate mixing. In addition to the mill, Pneulec, Ltd., exhibited a moulding machine. This is of the jarr, roll-over pattern type. The control of these movements is by oil. The machine demonstrated has a turnover plate 20in. by 36in. and a capacity of 750 lb. The Royer sand mixer, a well-known general utility machine, was also shown, together with the firm's "Silky-Sand" disintegrator. The features of this machine are that scrap shovelled into the machine with the sand can pass through harmlessly, also that even with the machine full of sand only a 3 h.p. motor is required to drive it.

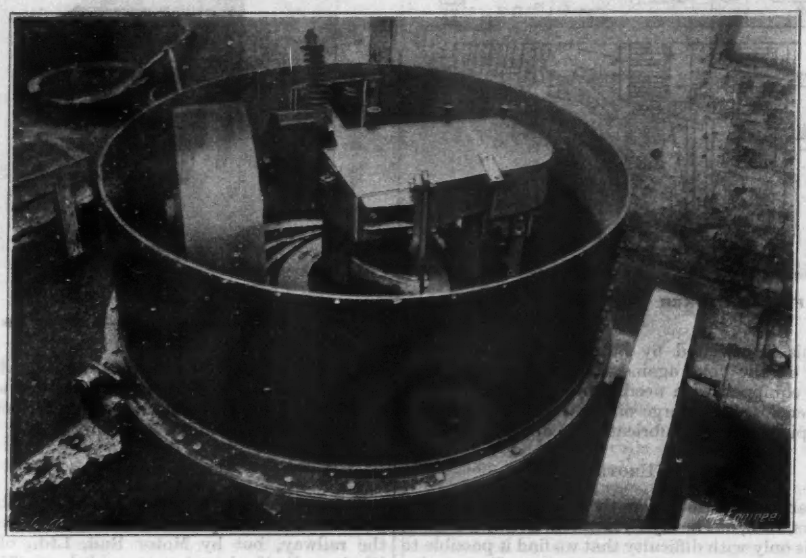


FIG. 44—SIX-FOOT MIXING MILL—PNEULEC

STEEL BAND CONVEYOR AND ENGINEERING COMPANY, LTD.

On the stand of the Steel Band Conveyor and Engineering Company, Ltd., there were to be seen several conveyors in operation. Three of them, 10in. wide at 20ft. centres, were arranged for the demonstration of how various materials can be handled. Loose materials were shown being discharged wholly or partly at certain points by fixed and travelling scraper ploughs. The bands were placed so as to interlace with one another, and arranged so that material could be transferred from one to another. Suitable arrangements of small bore pipes demonstrated how material can be moistened in transit and scrapers were so placed as to mix the material. Another exhibit was a similar conveyor, 10in. wide by 18ft. centres, passing through an oven which was gas-fired to maintain temperatures up to 600 deg. Fah. It would be suitable for the making of biscuits, swiss roll, sponge cake, &c., and represented the type of plant the firm supplies for drier tunnels. In order to demonstrate that conveyors of very considerable widths are made, a portion of a conveyor 12ft. 10in. wide, supplied for handling cube sugar to a depth of 5ft., was shown on the stand. The conveyors exhibited in action were all driven electrically from small motors through "Radicon" worm gear reducers made by David Brown and Sons (Huddersfield), Ltd.

THE RAPID MAGNETTING MACHINE COMPANY, LTD.

On the stand of the Rapid Magnetting Machine Company, Ltd., there was to be seen among many other exhibits an electro-magnetic separator for feebly magnetic ores which is claimed to have considerable advantages over older patterns. A view of the machine is reproduced in Fig. 45, from which its general arrangement will be observed. It is said that wolfram tin of minus 20 plus 30 mesh has been separated at the rate of 8 cwt. per hour at a feed belt speed of 240ft. per minute, and ilmenite from black sands at a belt speed of 878ft. per minute. The manner in which this high capacity has been obtained is shown by the line engraving, Fig. 46. Two feed belts are used, passing in opposite directions beneath the periphery of a rotating magnet disc. The disc periphery travels at a speed higher than that of the belt and picks up the magnetic material as it passes, dropping it into a central chute. As compared with a system in which one disc rotates above one belt, the new principle has the advantages that the feebly magnetic material remains in the magnetic field for a very much greater time despite the fact that the belt is moving faster; and that the magnetic disc is travelling along the path of the conveyor instead of across it, so that it does not become overloaded or tend to sweep the material off the conveyor. Used in tandem, two or more machines of this type are capable of effecting a separation of materials of different magnetic permeabilities, each machine being adjusted to suit the permeability of the particular constituent to be separated.

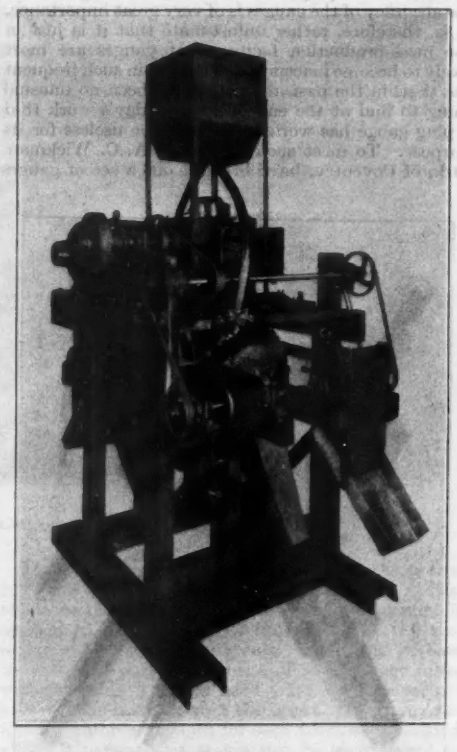


FIG. 45—ORE SEPARATOR—RAPID MAGNETTING

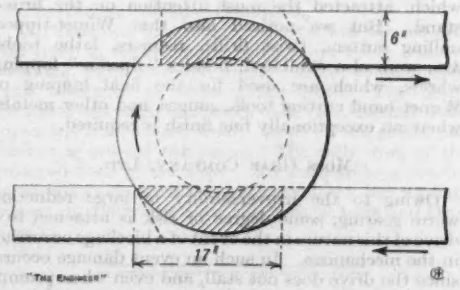


FIG. 46—MAGNET DISC AND FEED BELTS

The power required to drive these machines varies according to the setting of the separating discs, but 2 to 3 h.p. is usual. Either an A.C. or a D.C. motor may be used, but D.C. is required to operate the magnet, which, at 110 volts—the most suitable potential—will absorb a maximum of 7 amperes.

MASS PRODUCTS, LTD.

Modern press tools are becoming almost daily more exact in their operation. Pressed metal work, owing to the large number of articles turned out per hour, requires that the press should operate with great exactitude if feeding is to be uninterrupted and

if serious wastage of material is not to take place. We illustrate in Fig. 47 the latest pattern of the Humphris presses fitted with the gripper feed. The press mechanism, which is of the double knuckle-joint type, made its appearance last year. The new gripper feed is a means whereby a continuous strip of metal is fed under the press without human adjustment. Four cross bars hold the strip firm, two feeding in and two feeding out. Two of these bars lift as the press rises, enabling the other two to move the strip forward. As the plunger starts to descend the second two take up a new position, holding the metal firmly for the blow and ready to move it forward again when the plunger rises. The operation of these cross bars is by cams operated individually

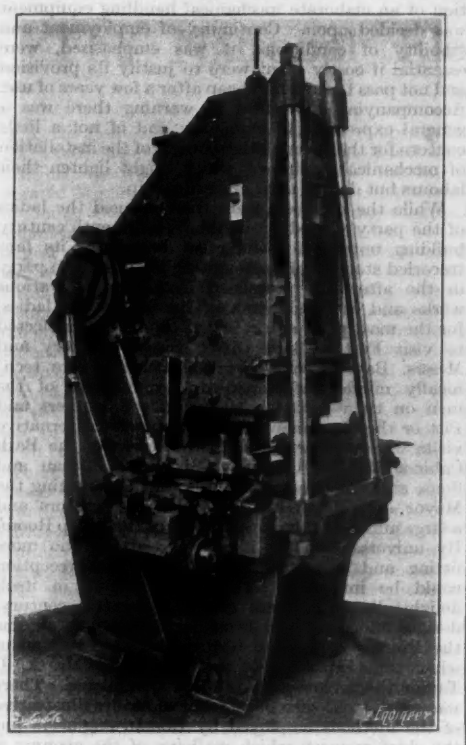


FIG. 47—METAL PRESS—MASS PRODUCTS

from the press motion. Three adjustments for the feed are provided, the final one being fitted with a micrometer screw. The nicety attainable by this means was demonstrated on the stand, the press making small articles three at a time from a strip of 1in. wide brass. The brass left over had an even thickness all round, which proves the exactitude of the feed mechanism. Various sizes of press with and without the gripper feed were shown operating on this stand.

W. AND T. AVERY.

Among the exhibits of W. and T. Avery, Ltd., of Soho Foundry, Birmingham, were automatic grain-mixing scales—Fig. 48—electrically controlled and

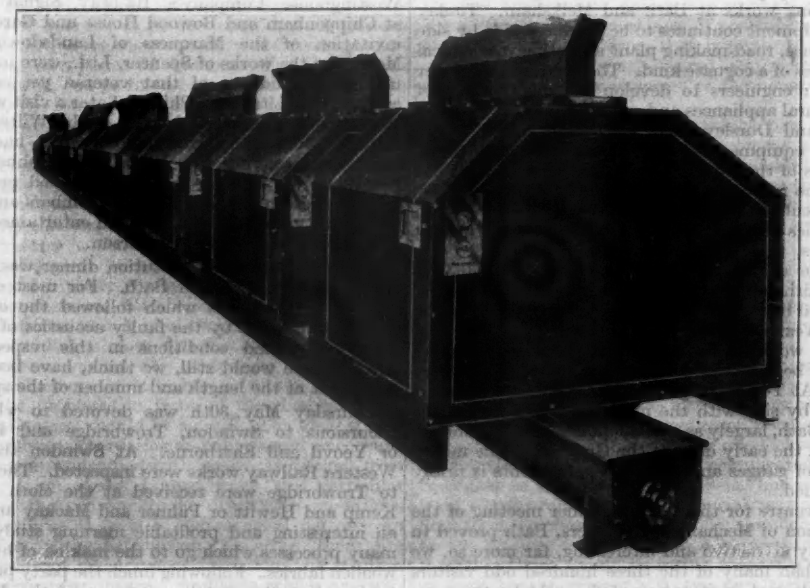


FIG. 48—GRAIN MIXING SCALES—AVERY

synchronised, so that they can discharge together. Any number of these scales can be incorporated in the circuit, and are usually supplied in batteries for the exact weighing of ingredients for making a perfect mixture. A bulk milk weigher, a counting machine, an Avery-Goodbrand textile conditioning scale and oven, a representative selection of visible weighers for the retail trades, and a range of modern self-indicating testing machines, were also exhibited. An associated company, Avery-Hardoll, Ltd., was showing its latest electric petrol meter pump on the stand.

MELDRUMS, LTD.

Exhibited by Meldrums, Ltd., of Timperley, Manchester, there was to be seen at the Fair a new fan draught mechanical stoker similar to those illustrated

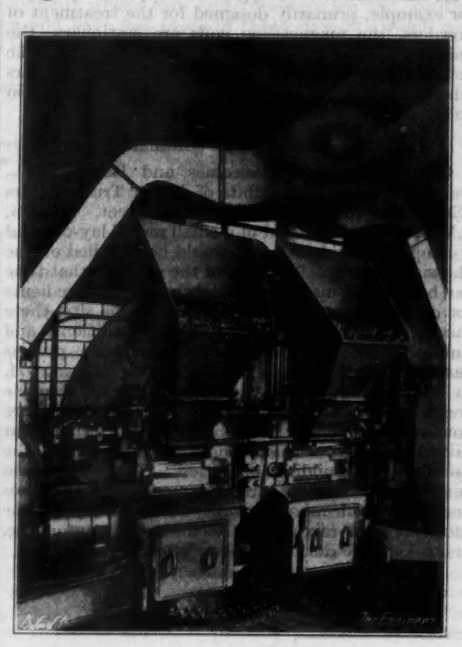


FIG. 49—MECHANICAL STOKER—MELDRUMS

in Fig. 49. The motor driving the stoker is placed on the front below the gear-box in an accessible position, and a second motor drives the fan. Efficient operation of the stoker and fan is therefore obtained, regardless of the head of steam in the boiler. One of the smaller sizes of the firm's large range of steel-cased incinerators was also shown with a cross-tube water heater arranged in the chimney. A new type of heater has been evolved by the firm in which the whole surface of water tubes, headers, &c., is utilised as heating surface. Those familiar with the products of the firm no doubt recognised on the stand numerous well-known devices, among which may be mentioned acid resisting metals, represented by the body of a centrifugal pump and various cocks and valves; the smoke-preventing door for vertical and locomotive type boilers; and hand rocking fire-bars.

BRITISH SANGAMO CO., LTD.

Prepayment house service meters, taking one, two, or three coins in one slot, were among the exhibits of British Sangamo Company, Ltd., of Cambridge Arterial Road, Enfield, Middlesex. One of the most interesting of these meters is the three-coin meter which takes shillings, sixpences, and pennies in one slot, and offers the advantage that the consumer can use the coin he happens to possess. Equipped with the Sangamo "H.M." element, the meter has all the essential features of a prepayment meter, such as fraud-proof devices. Sangamo fixed-charge collectors, which can be fitted to all large-base prepayment meters, were also on view. They are designed to collect from ½d. to 1s. 10½d. per week in ½d. steps; 1d. to 3s. 9d. per week in 1d. steps; or 2d. to 7s. 6d. per week in 2d. steps. The rate of collection can be easily varied in less than a minute without the removal of the meter cover, and an arrears dial measuring arrears up to 20d. is incorporated.

A new device exhibited was the Sangamo splitter block, which consists of a moulded bakelite case containing two terminal studs suitable for insertion into the load side of the meter, and by means of the block three separate circuits can be conveniently connected up to the meter without the branching of wires. As one of the terminal studs is adjustable, the block can be fitted to meters of all makes. It is made for currents of 2½ to 20 ampères and 25 to 50 ampères. Besides Sangamo polyphase meters, there were time switches. The standard Sangamo time switch is a synchronous model controlled by a self-starting synchronous motor, the timing and switching mechanism being enclosed in a meter type weather-proof aluminium case, with a separate terminal chamber. The switch can be supplied with a solar dial and with advanced or late time cut-outs. It can also be supplied with a power reserve of nine to twelve hours, which operates the switch in the case of current failure. In another type of time switch the same kind of synchronous motor is used to wind a main spring, and this switch can also be fitted with advanced or late time cut-outs.

THE MIDLAND SAW AND TOOL COMPANY, LTD.

In Fig. 50 we illustrate one of the band saws exhibited on the stand of the Midland Saw and Tool Company, Ltd., of Midsaw Works, Summer-lane, Birmingham. Several types were shown, the one illustrated being a slow-speed saw for use on steel.

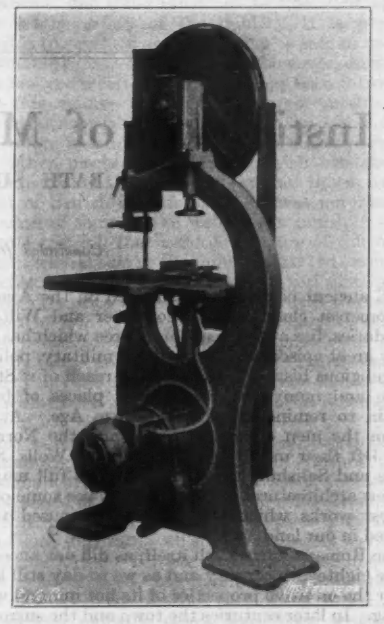


FIG. 50—SLOW-SPEED BAND SAW—MIDLAND

The motor drives through a reduction gearing to be seen immediately under the centre line of the table. A convenient tensioning device is fitted to the upper pulley. This is operated by a hand wheel situated where it is immediately to hand for the operator, who does not have to suspend his work to adjust the saw tension. Another interesting machine was the Midland electric sliding overhead cross-cutting and grooving machine. This machine consists of a rotary saw mounted on the shaft of a 2 h.p. electric motor. The motor is mounted on a horizontal arm and can be rotated round it. This arm is itself rotatable round a vertical pillar mounted on the framework. The vertical height of the horizontal pillar, as well as the radius of the motor from the vertical pillar, are both adjustable, so that there is practically no angle of cut which this saw cannot attain. The table is fitted with adjustable side clamps and the table can be moved forward when required, so that full advantage may be taken of the length of cut for various thicknesses of timber. The use of ball bearings and of aluminium alloy has rendered the movements easy, while the various angles are clearly marked out and provided with suitable stops.

BROOKES (OLDBURY), LTD.

On the stand of Brookes (Oldbury), Ltd., of Birmingham, there was an interesting demonstration of the latest pattern automatic wire-drawing machine. The machine was totally enclosed, and ran smoothly and satisfactorily. The oil cooling mechanism between the dies was of particular interest. In addition, a two-high reversing strip mill was on view. This mill has been produced to handle particularly long orders and the method of reversing the motion by means of clutches was of special interest. Finally,

an associated firm, J. C. Brookland, of 20, Waterloo-street, Birmingham, were exhibiting the Gerhardi quick-action press for synthetic resin mouldings, of which they are the constructors. The features of this machine are the control of the ram, which is obtained by means of a toggle system and is operated electrically. Very small current consumption is claimed, owing to the use of the motor only when the ram is in motion. A special coupling controls the pressure sensitively and acts as a safety device against overloading. The press was particularly accessible, owing to its open construction, access being from three sides.

WILLIAM ALLDAY AND CO., LTD.

On the stand of William Allday and Co., Ltd., of 38A, Paradise-street, Birmingham, was exhibited a comprehensive range of small furnaces heated by gas and designed for the heating of soldering irons and similar operations. The furnaces are thoroughly practical in design, being compact and portable, and the insertion of the irons can be effected from either side enabling two operators to use the same furnace without getting in each other's way. A useful fitting was shown on a hot brass stamping furnace. This consists of a double cock which controls the flow of air and gas together. Considerable economies are claimed for this cock, as it prevents the usual wasteful practice of putting the furnace out of action temporarily by cutting off the air supply only, and leaving the gas burning at full bore with no draught. A range of "Wilkes" industrial gas burners was shown, as well as the "Alcosa" fan forge. This is oil fired, and is of the portable type.

ELECTROMAGNETS, LTD.

Magnetic extractors and separators of the chute, rotary drum, pulley jig shaker, and vibratory types for extracting tramp iron from material in order to prevent damage to crushers, disintegrators, pulverisers, &c., were exhibited by Electromagnets, Ltd., of 2, Church-street, Colmore-row, Birmingham, 3. There was a rotary type separator and small accessories as used in the non-ferrous industries for sorting mixed ferrous scrap, swarfe, casters, ashes, &c., and a lifting magnet, suitable for service in steel works, foundries, rolling mills, &c., for handling pig iron, skull cracker balls, and finished materials, such as sections, girders, plates, &c. Many new features are said to have been incorporated in the products that were exhibited. In the jig shaker type of separator, for example, primarily designed for the treatment of powders, the magnetising coils are stationary, the only moving portion being the tray fitted above the coil box, and above the face of the tray there are bars which are magnetised by induction from the main coils.

JAEGER TRUCK MIXERS (ENGLAND), LTD.

On the stand of Ransomes and Rapier, Ltd., were to be seen the exhibits of Jaeger Truck Mixers (England), Ltd., of 54, Victoria-street, London, S.W.1. These consisted of a small model lay-out and a complete mixing set as it would be installed on the chassis of a lorry. The idea of the mixer is that time can be saved if, instead of transporting the ingredients for concrete manufacture in lorries to the site, there mixing them, often under difficult conditions, and finally using the concrete, the mixing process can be performed on the lorry during transit. If, in addition, the lorry is equipped with an accurate weighing and mixing device, better and more consistent concrete will be produced than that mixed under the usual conditions applying in the middle of a building operation. The installation consists of drums to carry the necessary quantities and a central mixing drum which rotates. The metering and mixing are accurate and automatic, and take place during the lorry's journey.

(To be continued.)

Institution of Mechanical Engineers.

BATH SUMMER MEETING.

No. II.

(Concluded from page 569, May 31st.)

THE ancient city of Bath, situated on the Avon in Somerset close to the Gloucester and Wiltshire boundaries, lies at the heart of an area which has seen many great episodes in the nation's military, political and religious history. Within easy reach of it Stonehenge and many less conspicuous places of burial remain to remind us of the Bronze Age. At Old Sarum the men of the Iron Age and the Normans have left their mark. At Glastonbury, Wells, Sherborne and Salisbury, in ruins or in the full majesty of their architectural beauty, we may see some of the earliest works which Christian piety caused to be erected in our land.

The Romans knew Bath itself, as did our ancestors of the eighteenth century and as we to-day still know it, for the curative properties of its hot mineral water spring. In later centuries the town and the surrounding country found favour in the eyes of fashion. Many are the names of the famous men and women whose residence within the city is recorded on the mellowed stone walls of its houses. Outside its bounds numerous country seats—Ammerdown, Bowood, Longleat and others—cluster about it, adding beauty and dignity to the history, romance and legend which cling to the city and its neighbourhood.

Of the industries indigenous to the district all have their origin in the soil. The area is essentially an agricultural one—the coalfields lie farther to the west—and almost every branch of farming and of those industries which draw their raw materials from the farm is represented within it. Dairying, carried on to-day for the most part in large central factories producing cream, condensed milk and cheese, provides a large measure of employment. At Yeovil the glove-making industry has its headquarters, although it must be recorded that the skins used now come almost wholly from overseas. At Bradford a few miles from Bath the Flemish wool spinners and weavers first settled on coming to this country. Later they migrated to Yorkshire taking the name of their village with them but their industry is still carried on at Trowbridge and Dursley where the justly famous West of England cloths are produced in immense variety. Here as at Yeovil the manufacturers are no longer wholly dependent upon the local farming industry for their raw materials, the wool used now being obtained largely from Australia. As an offshoot of the woollen industry carpet and rug making are practised at Dursley and Wilton. At Chippenham and Calne the bacon industry provides extensive employment and at Bath itself the bakery trade, famous for its buns and biscuits, is firmly established.

One other indigenous industry, of the soil but not of the farm, must be mentioned. The local quarries continue to provide the variety of calcareous sandstone known as Bath stone and employed for many ages past as a building material. In the smoky atmosphere of London and other cities the stone may be deficient in resistance to chemical action but in Bath and its neighbourhood its all but universal employment proves its permanency under suitable conditions.

The area has other industries which have come to it indirectly. At Bath cabinetmaking and the manufacture of clothing of one kind or another are practised on a considerable scale and, as the birthplace of Sir Isaac Pitman, printing and bookbinding are, almost naturally, included among its activities. The engineering and kindred industries of the city and its neighbourhood have in part their origin in the mechanical needs of the local trades and in part have been established more or less adventitiously. The quarrying industry gave rise to a demand for mechanical handling equipment and led to the establishment of engineering works at Bath and Melksham. To-day such equipment continues to be produced side by side with cranes, road-making plant and other mechanical appliances of a cognate kind. The needs of the farmer led other engineers to develop the manufacture of agricultural appliances and small power plants and at Yeovil and Dursley there are to-day works which produce equipment of this kind which goes to all countries of the world. The process of evolution has now come full circle; the power plants produced by the agricultural engineers are to-day being used in the cranes made by those who started as quarry engineers.

Of the extraneous industries established in the neighbourhood of Bath first place in its effect on the industrial history of the district must be given to the Great Western Railway Company's locomotive and carriage works at Swindon. India-rubber manufacture has been carried on at Melksham for nearly fifty years. At Yeovil the production of aircraft is carried on side by side with the manufacture of oil engines and at Bath, largely as a development of the country's needs in the early days of the Great War, the manufacture of gauges and scientific instruments is firmly established.

As a centre for this year's summer meeting of the Institution of Mechanical Engineers, Bath proved to be highly attractive and interesting, far more so, we know, than many of the three hundred odd visitors who took part in it anticipated would be the case. Socially the meeting provided several events which will linger pleasantly in the memory for a long time. Following an admirable recent precedent the President, Col. A. E. Davidson, and Mrs. Davidson, held an informal reception on the evening of Monday, May 27th, at which the members and their ladies had an early opportunity of renewing old friendships and making new acquaintances. The real opening of the meeting took place on the following day when the Mayor of Bath and the members of the Reception Committee welcomed us to the city at the Pump Room. Subsequently Mr. R. B. Lister presented a paper entitled "Mechanical Handling as Applied to Industry," in which he surveyed the use of mechanical handling equipment in ironfoundries, fruit and vegetable bottling and canning factories, brick, tile and pottery works, at breweries, at docks and on railways. The discussion which ensued would, we think, have developed into something worthy of a more serious occasion had time permitted. Mr. Asa Binns, Mr. Cecil Bentham, Mr. Gresley, Col. R. B. Pitt and Sir Ernest Petter took part in it. The general trend of their remarks covered the necessity for the exercise of much caution and close study before the installation of an elaborate mechanical handling equipment was decided upon. Continuity of employment and stability of conditions, it was emphasised, were essential if costly plant were to justify its provision and not pass to the scrap heap after a few years of use. Accompanying this word of warning there was a general expression of sympathy and of not a little concern for the effect on the workers of the installation of mechanical equipment which might lighten their labours but debase their craftsmanship.

While the members were thus engaged the ladies of the party visited Bath Abbey, a fifteenth century building notable for the great beauty of its fan-traceried stone vault. Reuniting for lunch the party in the afternoon proceeded in groups to various works and establishments in the city. The ladies, for the most part, and a few of the members elected to visit Fortt's Bath Oliver Biscuit Factory and Messrs. Bayer's corset works. Others, more technically minded accompanied the majority of the men on their visits to the works of Stothert and Pitt or the Horstmann Gear Company. Alternative visits were also arranged to the works of the Bath Cabinet Makers' Company, Sir Isaac Pitman and Sons, and other establishments. In the evening the Mayor and Mayoress entertained the visitors and a large number of the townspeople at the Pump Room. By universal consent it was agreed that no more fitting and attractive place for such a reception could be imagined. The Pump Room, in itself delightfully reminiscent of the eighteenth century, derives added interest from the fact that it adjoins the Roman Baths, the history and construction of which was explained to the visitors by Mr. A. J. Taylor the architect to the Spa Committee. There was much to be seen of a technical nature illustrative of the methods employed by Roman engineers but the chief memory which we have of the evening is less professional than social. The Mayor was a noble host. He entertained us to dancing, music and an exhibition of physical training by a group of enthusiastic young children trained to truly marvellous perfection by Captain Olsson. Withal the refreshments provided were on a scale which we have, in a considerable experience of such functions, never known surpassed.

On Wednesday, May 29th, alternative visits were paid to Bristol, Dursley, Chippenham and Calne or Melksham and Ammerdown. Those who visited Bristol inspected the engine department of the Bristol Aeroplane Company, Messrs. Fry's works and the Keynsham Paper Mills. At Dursley visits were paid to R. A. Lister and Co.'s works, to Hunt and Winterbotham's cloth mills and to Champion and Sons' carpet and rug factory. The third group visited Messrs. Harris' Bacon Factory at Calne, the Westinghouse Company's Railway Signal Works at Chippenham and Bowood House and Gardens by invitation of the Marquess of Landsdowne. At Melksham the works of Spencer, Ltd., were inspected under the guidance of that veteran yet energetic engineer Mr. Littlejohn Philip. Later a visit was paid to the milk condensing factory of the Wilts United Dairies. Joining up with a group which had meanwhile been visiting the Avon India Rubber Company's works the party having lunched proceeded to Ammerdown House where the members and ladies were most graciously received and entertained to tea by Lord and Lady Hylton in person.

In the evening the Institution dinner was held at the Assembly Rooms in Bath. For most of those present the speeches which followed the excellent repast were spoilt by the faulty acoustics of the old hall. Even had conditions in this respect been perfect there would still, we think, have been some complaint at the length and number of the speeches.

Thursday May 30th was devoted to whole-day excursions to Swindon, Trowbridge and Longleat or Yeovil and Sherborne. At Swindon the Great Western Railway works were inspected. The visitors to Trowbridge were received at the cloth mills of Kemp and Hewitt or Palmer and Mackay and spent an interesting and profitable morning studying the many processes which go to the making of high-class woollen fabrics. Following lunch the party proceeded to Longleat the stately residence of the Marquess of Bath and later on the return journey took tea at the delightfully situated home of one of the members, Mr. W. N. Haden. The third party visited Messrs. Petter's oil engine and aircraft factory at Yeovil, Aplin and Barrett's Dairy factory and some glove-making establishments and later inspected Sherborne Abbey.

In the evening a reception and dance was held

at the new Technical College in Bath, an establishment of which the city has much reason to be proud and which will obviously promote the interests of all the local industries. The equipment of the building—a converted hospital—is as yet not complete but even already it promises to become an important centre of technical education in the West Country.

Friday the closing day of the meeting was given up to pure pleasure. Alternative visits were arranged which took one party to Salisbury, Old Sarum and Stonehenge and another to Cheddar, Wells Cathedral, Wookey Hole and Glastonbury Abbey.

The Institution of Mechanical Engineers has acquired a high reputation for the success of its summer meetings. They are in many ways functions of unusual character with serious business duly subordinated to the social side. The Bath meeting will be recorded in the memories of those who were privileged to take part in it as one of the most delightful and interesting of the series. To many kind friends of the Institution resident in the area the visitors were indebted for their enjoyment but a special tribute must be paid to the organising ability of General Mowat and his very able staff without whose care and consideration the meeting would have lost much of those elements which contributed to its success and pleasure.

The National Electrical Convention.

No. I.

AT the beginning of this week there opened at Bournemouth the first National Electrical Convention organised under the auspices of the Incorporated Municipal Electrical Association. Attended by some 3000 delegates from the leading electrical organisations of the country, it is claimed to be the largest conference so far organised by an individual British industry. One of its objects is to discuss the formation of a National Electrical Council to ensure co-operation between all sections of the industry for the good of the community. Other matters receiving attention are the standardisation of voltage, the cheapening of domestic apparatus, the standardisation of plugs, sockets, and flexibles associated with all electrical appliances, and the prohibition of the sale of unsafe electrical appliances. Manufacturers in all parts of the country are taking part in an extensive electrical exhibition devoted largely, but by no means exclusively, to domestic electrical goods, whilst practical demonstrations of the effectiveness of floodlighting equipment are being given by the electrical illumination of Bournemouth. Every firm specialising in floodlighting is taking part in this demonstration, which has been organised on an exceptionally elaborate scale.

On Monday morning there was a display of electric vehicles at the Pavilion Car Park, Bath-road, where the latest examples of battery vehicles were to be seen. In the evening there was a reception in the Pavilion Lounge by the President of the Convention, Mr. E. E. Hoadley, and Mrs. Hoadley, followed by dancing in the ball-room until midnight. The first technical session began on Tuesday, when the Convention was opened by the Mayor of Bournemouth. The President, Mr. E. E. Hoadley, then read his Presidential Address, of which the following is an abstract.

PRESIDENTIAL ADDRESS.

The chief and most important reason for the holding of a National Convention is to further the expansion of the industry. The grid scheme, under the Act of 1926, is completed, and it is desirable that the grid should be loaded up as quickly as ever possible, if the great success which such a scheme deserves is to be attained. The electricity supply industry has progressed very rapidly during the past few years, but it was felt that a National Electrical Convention would go far towards helping the grid scheme forward a great deal more rapidly than would otherwise be the case. To bring about this great expansion of the industry, it was felt to be necessary that all sections of it should get together and fully and freely discuss from their own points of view how this end, so much to be desired, can be furthered, and to get out of the way any hindrances there may be to this consummation. It was further felt that the publicity obtained throughout the country by a National Convention will materially assist in making the public more electrically minded and therefore more easily induced to avail themselves of the undoubted benefits that electricity can confer.

One matter which has been the reason for the spilling of a great deal of ink in the past few years, and on which many conflicting opinions are held, is the rationalisation, nationalisation, or socialisation of the distribution side of electricity supply. Several writers, holding almost directly opposite opinions, have written documents containing arguments—very convincing at first sight—as to the manner in which the problems in front of the distributors of electrical energy should be solved. The greater part of this problem is bordering on politics, and since we as engineers are concerned with policy, as distinct from politics, I am afraid I must leave this particular aspect of the problem to be dealt with by others, particularly as it is of a controversial nature. In connection with distribution, however, there are many problems which demand solution, and solution in the very near future; problems which are self-evident, and which should be solved within the industry and without either the pressure of Parliament or the pressure of public opinion.

These problems are:—(1) Standardisation of voltages; (2) standardisation of methods of charge; (3) standardisation of apparatus, particularly domestic apparatus.

For many years past articles of all sorts have appeared in the Technical Press on this subject, but even now little, if anything, has been done to remedy what is a definite hindrance to the expansion of the use of electricity, and a condition which is looked on by many members of the public as ridiculous, and I think you will admit, ladies and gentlemen, ridiculous it really is. What sound reasons can be advanced to excuse there being no fewer than fourteen public supply voltages in use in this country between 200–250 volts. Surely an industry which can pay a charge of £19,000,000 for the standardisation of frequency which, after all, does not touch the whole of the supply in this country, but only the alternating-current part of it, could at least afford another fifteen to eighteen millions which is the estimated cost of changing over to a standard voltage of 230 volts. Standard voltage affects the whole of the existing supply in the country, whether alternating or direct current, and I do not think that there will be many who disagree with my statement that it is one of the most pressing problems before the industry.

During the past year the I.M.E.A. has, by negotiation with the Electric Lamp Manufacturers' Association, arranged for putting on the market on June 1st, 1935, a lamp made by the associated manufacturers to be sold to the public at 1s. This is an achievement worth while, and both sides are, in my judgment, to be congratulated on the result of their deliberations; if only this standardisation of voltage could be brought about, there would very likely be an arrangement to put on the market a 6d. lamp, showing, I hope, a reasonable margin of profit to the lamp makers. In this problem of the standardisation of voltage we are apt to consider the initial cost and to be frightened by it, and we are prone to disregard to a large extent the enormous savings that will be made as the result of it, both within and without the industry. It will act as a corollary to the standardisation of frequency in the cheapening of apparatus, particularly domestic and other current-consuming devices, such as is bought by the public.

More perhaps has been written on the standardisation of methods of charge than on any other subject concerning the supply industry, and to-day we are no nearer finality than we were several years ago. I am afraid that it is much too Utopian to hope for a standard charge, at least for some time to come, but it should be possible and it is highly necessary that a standard method of charge should be evolved at least applying to domestic consumers. That it should apply to other classes of consumers is desirable, but it is imperative that it apply to domestic consumers, if the much-desired expansion in the use of electricity for purposes of the housewife is to become an actual fact.

Now that nearly all undertakings pay for their current on a two-part tariff, agreement should be sought as quickly as possible on a standardised two-part tariff for domestic users. There are three main methods of arriving at the first charge—(1) rateable value, (2) floor area, (3) lamps installed or lighting demand.

Whichever one of these three is ultimately adopted does not, in my judgment, matter very much. I personally cannot see what rateable value has to do with the cost of supply of lighting for a house, but should rateable value be the method adopted, I am quite prepared to forget any objections I may have for the good of the industry. Some time ago it was stated that all tariffs for electricity supply are a mixture of equity and expediency. Some of us in our pursuit of equity have rather overlooked expediency. Our tariffs may be as complicated and as equitable as we like to make them, but we should keep all the complications to ourselves, and in the final form, as offered to the public, simplicity should be the keynote. By this I do not necessarily mean that all charges should be in the form of a flat rate, at least not at present. A two-part tariff can be made simple and it certainly is equitable, while in my judgment a flat rate charge for lighting should, for many reasons, be kept up to a fairly high level. Lighting alone in many cases is not very profitable, and it is only by the offer of low rates for the other services that our charges are going to bring in the business which we all desire.

One of the most pressing problems at the present day is the very vexed question of plugs, or as they are known socket outlets. The I.M.E.A. and the plug manufacturers have had a joint committee at work on it and the British Standards Institution has issued at least two standard specifications, the last one being stated to be finality, and one that would, with the help of master gauges, give what was required by the ordinary public. My personal experience and trials with the master gauges has shown me that with some plugs sold to-day and catalogued as being standard, there is more interchangeability on the pages of the catalogue than exists in the plugs themselves. There is a way, and quite a simple way, of obtaining what everyone requires, but for reasons connected with patents and other matters it has not been found possible to adopt it.

Another similar problem affecting the domestic use of electricity is the problem of the flexible cord or cable, call it what you will. Everyone who has had occasion to use a piece of apparatus which has been put away in a drawer, complete with its flexible, for some months or even weeks, where the flexible is what is known as double silk or even cotton covered, will bear me out in my plain and unvarnished opinion of this abomination. Thanks to the joint efforts of the I.M.E.A. and the manufacturers, and with the assistance of the Electrical Association for Women, matters are improving in this direction, and non-kinkable, easily cleaned, durable, and presentable flexible cables are now obtainable. Equally important with these two items is the piece of apparatus on the other end of the flexible known as the adaptor. There is now available a standard adaptor, the use of which we hope will, in time, become universal. We should not have to wait for this time. Means should be sought whereby the use of one standard socket outlet and plug, one standard kind of flexible, made perhaps in two sizes, and one standard adaptor should be made compulsory.

In connection with the use of domestic electrical apparatus, one thing must not be lost sight of, and that is the safety of the public. It is perfectly possible to produce apparatus that is safe in use at a reasonable price. Unfortunately, however, during the past few years certain apparatus has been introduced into this country which is definitely unsafe. The Electrical Apparatus Committee of the I.M.E.A. has had before it samples of electric fires, socket outlets, and other pieces of apparatus which are absolute death traps. I am pleased to say that this apparatus is not of British manufacture. It was purchased at branches of some of the well-known multiple stores. When I tell you that a 2-kilowatt fire of the *de luxe* pattern was on sale to the public at 2s. 11d., complete with flexible, you may imagine what sort of an article it was. Its price had nothing to do with the opinion formed of it by the Apparatus Committee, but the sheet metal of which it was composed was easily bent by finger pressure alone and the sharp edge of a piece of this sheet metal was within one-hundredth of an inch of bare wire, giving a potential difference to earth of 230 volts.

This is only one example of unsafe apparatus of foreign origin, which is on sale in various places throughout the country, but not, I am pleased to say, in the shops of reputable electrical contractors. The I.M.E.A. has taken all possible steps to prevent the use of such apparatus, all supply engineers have been circularised, the British electrical manufacturers have been advised, the Electricity Commissioners have discussed the matter with the I.M.E.A., and the various multiple stores have been written to. All this is, however, only playing with the problem. What is wanted, and very urgently wanted, is that legislation shall be enacted to make illegal the sale of such apparatus, for it is only by stopping its sale that its use can be prevented.

Other problems before the industry, which should be energetically tackled at once, include the cheapening of distribution. Much is being done to cheapen the generation of electrical energy, but this only concerns the wholesale side of it. Equally energetic efforts should be made to cheapen what may be termed the retail side of the business, *i.e.*, the conveying of the energy from the grid points and other places to the consumers' terminals. The use of standardised apparatus, such as feeder pillars, distribution pillars, cut-outs, &c., will do something. Still more can be done by the use of boosters and balancers enabling full use to be made of the copper that is already laid in the ground, thus bringing about the advantage, that the heating of cables shall be the limiting factor of what they will carry, rather than, as exists at present in most cases, the pressure drop limiting the load which can be conveyed through the cables. Further research is, however, necessary in this connection, and those firms which are experimenting in this class of apparatus will earn the thanks of many supply engineers whose mains are becoming fully loaded. Enough has been said on these somewhat simple matters to fully justify my remark that something should be done, but even after having agreed this, the much more difficult problem now arises of when and how. In my judgment, the answer to the first question should be, At once. The answer to the second should be that a National Co-operation Committee or National Council or whatever you like to call it should be set up, to include representatives of all the Associations present here to-day.

(To be continued.)

A Birmingham Nickel Alloy Works.

IN our issue of May 17th we referred to the centenary celebrations at the works of Henry Wiggin and Co., Ltd., in Birmingham, and are now able to give some illustrations and particulars of these works.

As we have already explained, the business was started a hundred years ago by Charles Askin and Brooke Evans, in a very modest way in The Parade, Birmingham, and was later removed to the present site under the ægis of Henry Wiggin. Since then the works have steadily grown until they are now claimed to be the largest of their kind in Europe. They have also become associated with the Mond Nickel Company, and are consequently in a very strong position for the supply of nickel and its alloys throughout the world. During the past few years the equipment in the factory has been very largely renewed and modernised, and these notes are intended to give some impression of the new plant.

Starting with the melting department, of which we give an illustration on page 594, it should be pointed out that all the melting is done electrically. The equipment in this shop comprises two Heroult electric arc furnaces and an Ajax-Northrup high-frequency induction furnace. The Heroult furnaces are of 1¼-ton and 10 cwt. capacity respectively, and are used for melting electro-nickel and scrap up to one-third of the charge, in the production of depolarised nickel anodes, nickel for sheet and strip, &c. The high-frequency furnace, for which the charge consists of nickel pellets and high-grade, low-carbon chromium, is used for making chromium alloys. Nickel-chromium iron, nickel-iron and nickel-copper alloys are also melted in this furnace.

The hot rolling mill, which we illustrate, to which the cast ingots are first taken, is equipped with several modern mills. One of these is of the three-high Universal type with rolls 18in. by 21in., with front and back tilting tables, so that man-handling is eliminated between the passes. It is used for rolling sheet, bar, and strip. The other mill, the most recent addition to the plant, is of the Lauth type. It, also, is three-high and has rolls 52in. long, with front and back tilting tables. It is used for rolling sheet and runs at a linear speed of from 250ft. to 300ft. per minute. There is also a continuous mill for rolling strip.

The billets are fettled in this shop by means of pneumatic cold chisels to remove any surface defects which might be perpetuated in the subsequent processes, and the material is thoroughly inspected at this stage. There is also a lathe, of which we give an illustration, fitted with a relieving action for turning square ingots to remove the surface metal of doubtful properties. There is a special department for turning the mill rolls, which are either of chilled cast iron or cast steel, equipped with a number of lathes and a Churchill grinder. The rolls for the finishing processes are buffed, to give them a high polish and are finished with an accuracy of one ten-thousandth of an inch.

There are two other mills, the cold-rolling mill and the rod mill. The cold-rolling mill takes the heavy hot rolled sheets from the first mill and reduces them in stages, with intervening annealings; but some of the alloys, such as nickel silvers, are entirely cold rolled from the ingot stage. It is in this department that the highly polished rolls just referred to are used to give a special finish to some sheets.

The annealing shop is adjacent to the cold mill and is equipped with electric furnaces in which the metal is heated in an atmosphere of butane to prevent it from oxidising. The gas is supplied from cylinders which are housed in racks against the wall and is admitted to the furnace through reducing valves. The sheets to be annealed are carried continuously through the furnace on an endless woven belt of nickel-chromium iron, and its long service is a testimonial to the heat-resisting qualities of this alloy. At the inlet and outlet doors of the furnace there are curtains of Monel metal chain which provide a sufficient seal to prevent much leakage outwards of the butane gas.

In the rod mill the fettled bars are rolled hot to the sizes required by the wire department, and are annealed in a rather unusual type of furnace by the Birmingham Electric Furnace Company. The coils of rod are placed in this furnace in baskets, and after they have been raised to the requisite temperature are lowered into a pit of water containing 3 per cent. of alcohol, which acts as a cleaning agent. The load is lowered automatically into the solution, quenched, and brought to the surface again. This is the process with copper-nickel alloys, but nickel-chromium rods are open-annealed, pickled, and then coated with a special alloy which facilitates subsequent drawing down to wire.

Depolarised anodes for electro-plating baths are also produced in this department, the metal being rolled to an oval section, cut to length, and finally drilled and tapped to receive the nickle hooks by which they are suspended in the bath.

There are two wire-drawing mills with a large number of draw-benches of a type familiar to our readers, besides some continuous machines of the Hesse and Jager and Kratos types, rolls for flattening wire into strip, and furnaces for bright annealing. Some of these are arranged in vertical fashion and use hydrogen as a non-oxidising atmosphere. Wires down to 0·001in. diameter are regularly drawn in this department.

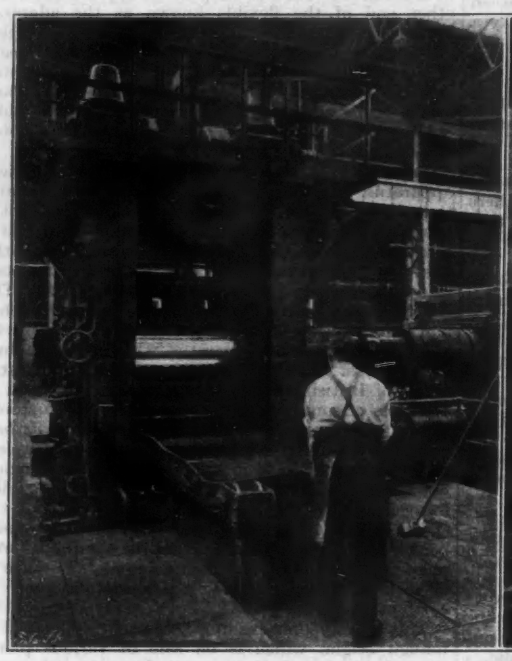
In connection with the wire mills there is a pickling shop in which there is installed a Taylor machine. The wire rods are placed in crates of "Brightray," an 80/20 nickel-chromium alloy resistant to the attack of acids. Although these crates have been in service for over two years they show no signs of attack. For general purposes straight sulphuric acid is used, but for the pickling of Monel metal, where complete scale removal is required, a mixture of sulphuric acid and sodium nitrate is used. This department handles about 30 tons of material a week.

There is an extensive range of laboratories where routine work, such as the testing of every coil of resistance wire or tape is carried out and research into new developments in the technique of nickel alloys promoted. Adjacent to the laboratories there is a shop where diamond wire-drawing dies are pierced and polished. Diamonds are used for gauges ranging from 0·002in. to 0·0226in. and tungsten carbide dies for sizes from 0·0253in. to 0·25in.

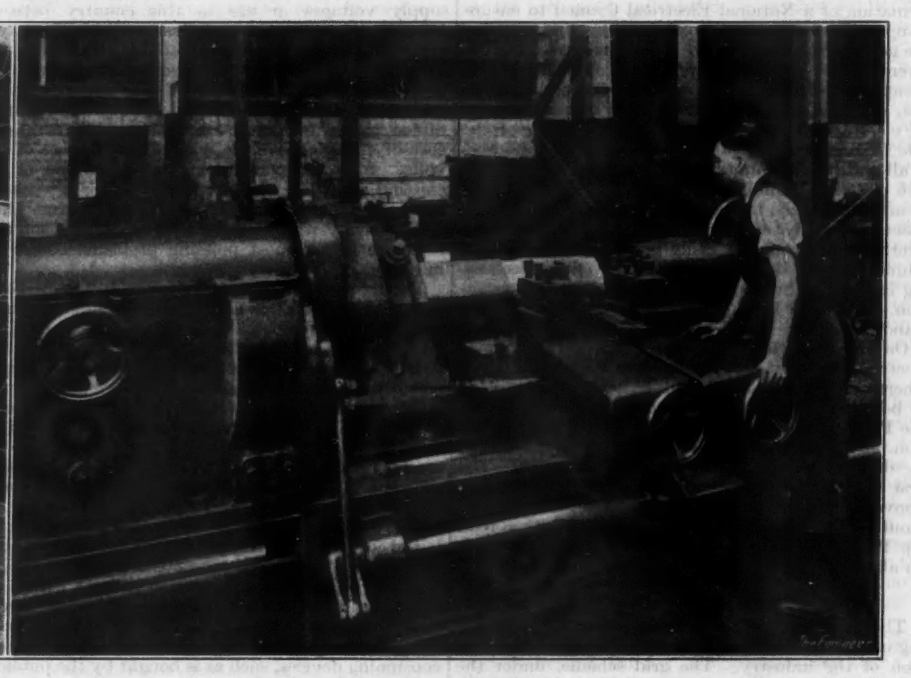
A large proportion of the company's produce goes towards the manufacture of blanks for spoons and forks, which are stamped out and shaped to pattern, annealing and pickling operations being necessary between the various stages. When complete the blanks only require filing, buffing, setting, and, if required, plating. Some 200 to 300 tons of metal are used in this department annually.

Anode casting, as distinct from rolled anodes, is done in a special building by the canal side, the interior of which we illustrate. It is equipped with a 10 cwt. Heroult furnace. After casting the anodes have their edges trimmed on a carborundum wheel, the holes are drilled for the hooks, and the casting is then sand-blasted. Anodes ranging in weight from 1 lb. to 2 cwt. are made in this shop.

It will be appreciated that the works require a considerable amount of electric power, and this is drawn from the Corporation mains at 11,000 volts. The three-phase current is transformed down in the company's own sub-station, which has a capacity of 6000 kVA, to 400 volts, 50 cycle, three-phase for distribution throughout the works. The plant comprises four transformers, each of 1500 kVA, and an elaborate switching gear especially designed to give elasticity and adaptability to extreme variations in load conditions. The low-tension connections are made with bare copper wires encased in sheet steel trunking. Excluding fractional horse-power motors there are 300 motors in the works with a total rated horse-power of 6700. There are also twenty-four furnaces and a lighting and heating load of about 250 h.p. The increase in the activity of the works within recent years may be gauged from the fact that the main watt-meter shows an advance from 2,712,230 units in 1931 to 6,128,000 units last year. For supplying the works with water there is an artesian well 503ft. deep by 12in. in diameter, which gives a flow of 15,000 gallons an hour.



MONEL METAL SHEET MILL



SQUARE INGOT TURNING LATHE

Electrical Factory Extensions at Prescot.

GROWTH of the electrical accessories business of British Insulated Cables, Ltd., has necessitated rearrangement and considerable enlargement of the electrical fittings department at Prescot, and to increase the output of meters of various kinds a special building has been erected and equipped. The new shop is a two-storied building, 272ft. long by 50ft. wide, and advantage has been taken of a falling site to provide a basement beneath two-thirds of the length.

Stores for raw material, dipping, degreasing, plating, bronzing, cleaning, and enamelling plant are in the basement. Much of the ground floor space is laid out as a machine shop; the remaining space is devoted to a test-room and a store for finished meters. Automatic machines of the latest type for turning out small brass parts, multiple-spindle high-speed drills, presses, gear cutters, hobbing machines, &c., driven in most cases by self-contained motors, have been installed in the machine shop. Other machines, including the larger presses, are belt driven.

Finished parts from the machine shop are transferred to the first floor on which they are inspected, and then passed on to be assembled on a large area of this floor with room for expansion. During the year or longer period the magnets are kept in storage before they are passed for use, they are subjected to repeated testing. From the assembly inspection room, at the other end of this floor, the finished meters are taken down to the test room on the ground floor, and thence to the finished stores and dispatch department. The meter shop is now fully equipped and staffed, and space is now available in the older parts of the department for the rearrangement of other sections. One of the most important of these changes, now practically complete, is the transfer of the welder department to a large shop previously used for the purpose of accessory assembly. The roof of this new welder shop has been raised and a 7½-ton electric travelling crane installed, together with modern machine tools and power supply gear, with a capacity of 750 kW, for testing welders under working conditions. Other recent additions include a new dressing shop for iron castings, with a floor area of 10,000 square feet, and a platform connecting three cupolas in the ironfoundry, with a storage space on the platform for 100 tons of pig iron.

BOOKS RECEIVED.

Problems in Electrical Engineering. Second edition. By S. Parker Smith, D.Sc., M.I.E.E. London: Constable and Co., Ltd., 10, Orange-street, W.C.2. Price 5s. net.

Practical Hints on Patents. Fourth edition. By M. E. J. Gheury de Bray. London: Imperial Patent Service, First Avenue House, High Holborn, W.C.1. Price 1s. net.

The Operation of Motor Ship Auxiliary Machinery. Vol. II. By J. Lamb, A.M.I. Mech. E. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C.2. Price 12s. 6d. net.

The Directory of Contractors and Public Works Annual, 1935. Edited and compiled by C. W. Biggar. London: Wightman and Co., Ltd., 104, Regency-street, S.W.1. Price 17s. 6d. net.

Rail and Road.

A NEW train consisting of eight carriages, which, owing to the extensive use of high-tensile alloy steel, weighs some 40 per cent. less than an equivalent train of carbon steel construction, has been completed for the Baltimore and Ohio Railroad. A similar type of train constructed of aluminium alloy is nearing completion.

MORE than 7000 miles of important main roads patrolled by the Automobile Association have no footpaths at all. Roads without footpaths represent 78 per cent. of the mileage in Devon and Cornwall, 68 per cent. in Sussex, 67 per cent. in South Wales, 64 per cent. in Scotland, 61 per cent. in the Western Counties, 55 per cent. in East Anglia, and 52 per cent. in Hampshire.

BY the standard regulations under which passengers' tickets are issued, the railway companies have no responsibility in respect of injury to those who pay less than the ordinary full fare. We believe that this does not apply to tourist tickets nor to the monthly return tickets, but as several cases in the courts have shown, it governs such facilities as the cheap day return ticket. It is of interest then to learn from the Labour correspondent of *The Times* on May 17th that the railway companies have promised to give sympathetic consideration to representations made by the General Council of the Trades Union Congress with regard to the limit of liability in respect of injuries to passengers holding cheap tickets and workmen's tickets.

THE announcement on page 564 of our issue of May 31st as to the L.M.S. Company having adopted metal instead of wood for signal posts, does not indicate a new departure; in fact, the use of lattice posts is a reversion to a type used over seventy years ago and still to be found on many English railways, and more so on the Scottish. A paper by Mr. R. C. Rapier, read at the Institution of Civil Engineers as long ago as March 31st, 1874, spoke of the "light and elegant posts . . . of lattice iron." In the adoption of tubular iron posts for signals less than 30ft. high above rail level, the procedure of the present-day colour-light signals is being extended. What is quite new is the painting of the posts in alternate black and white bands, as in the street traffic signals.

SEVENTY years ago there were two serious railway accidents within two days of each other. On June 7th, 1865, eleven passengers were killed at Rednal, on the Great Western, through a derailment caused by the driver running at an unsuitable speed after having had a "caution" hand signal exhibited to him on the approach of his train to a newly relayed road. Two days later came the Staplehurst disaster on the South-Eastern, which gained some notoriety because Charles Dickens was a traveller in the train. At that period there was no fixed timing for the boat trains, and it varied from day to day to suit the tide. On the day in question the ganger misread the time for the up tidal train, and the line was under repair, without proper protection, when the train approached. Ten passengers were killed.

OF all the street traffic signals used in Great Britain, 51·5 per cent. are of the original "fixed time cycle" pattern, which operates without direct relation to the fluctuation of traffic. A year ago, however, 75 per cent. of all installations were of this type. A statistical survey just completed by the Automobile Association showed how the modern "vehicle-actuated" signals are steadily replacing the less flexible and older pattern throughout Britain. The greatest progress has been made in the South. Elsewhere, however, there is little evidence of improvement. Ninety per cent. of all traffic signals in Surrey are vehicle actuated, 80 per cent. in Kent, 76 per cent. in the London traffic area (including most of Middlesex), 72 per cent. in Sussex, 63 per cent. in Liverpool and North Wales, and 54 per cent. in Essex. In no other A.A. area does the proportion reach 50 per cent.

PRIOR to the war, there was a scheme, the cost of which was estimated at £40,000, for reconstructing the Upper Medway Navigation for a distance of 16 miles from just above Tonbridge to Maidstone. The sum of £33,000 was raised locally and £7000 was advanced by the Development Commissioners. The cost proved to be much greater than was anticipated, and in 1913 a further loan was advanced. Floods delayed and damaged the works, and in the following year it was found that owing to mistakes in design and execution, a large extra cost had to be met if the scheme was to be carried through. Eventually, the Conservancy owed £40,000 to the Development Commissioners, but the scheme has proved to be a costly failure, and the report of the Commissioners for the year ended March 31st, 1934, records that the debt and interest have been remitted conditional on the local authorities relaxing their claim.

THE first railway accident of the present year to be reported upon was a collision on January 18th at Moses Gate, the first station south of Bolton, L.M.S.R. There are some carriage sidings on the down side of the railway, access to which is obtained by a connection of the down loop. The latter line starts at Moses Gate and is entered by facing points in the down main line. South of the facing points is a connection from the up loop. On the evening in question an empty carriage train was propelled from Bolton along the up loop, and on its arrival at Moses Gate it should have been drawn through the connection just named and have passed through the facing points into the down loop and been there backed into the carriage sidings. Unfortunately, the signalman failed to open the facing points, and the train continued on the down main line until the driver, who, in the dark, had not noticed the error, thought that he had gone far enough to clear the carriage sidings points. Discovering then his mistake, he sent his fireman to the box, but before that man arrived there the signalman, who, first, was unaware of his omission to move the facing points, and then did not recognise that the tail lamp of the empty carriage train was on the main line, had accepted and lowered his signals for a slow passenger train. In the collision which resulted there were no serious injuries. The signal for leaving the up loop applied to going to either the down main or the down loop, and Colonel Woodhouse, in reporting on the accident, recommends that this be changed.

Miscellanea.

A DIRECT radio-telephone service is shortly to be put into service between Tokyo and Siam.

IN his Presidential Address before the Institute of Welding, Sir Alexander Gibb said that there are some 2500 tons of steel in a set of welded gas purifier boxes at Billingham.

A RAILCAR erecting shop is being erected by the Associated Equipment Company, Ltd., on ground adjoining its Southall Works, where bus, coach and lorry chassis are made. The building will be 100ft. long with a clear span of 60ft., and will contain four roads. Provision has, however, been made for a future extension should this become necessary. One road will be provided with a fully lighted pit, 60ft. in length.

THE Sixth International Congress for Scientific Management is to be held at the Central Hall, Westminster, from July 6th to July 10th. Some two hundred papers have been prepared, and the series of conferences will cover the problems of practical management in relation to industrial, commercial, agricultural, and domestic matters. A comprehensive hospitality programme has been arranged, and to conclude the Congress visits of factory inspection covering representative types will be available to members. Special tours have been planned for the particular benefit of foreign members so that they may see examples of industrial and commercial organisation.

PARTICULARS of the electrolytic production of zinc in the new works erected at Magdeburg by the Zinkelektrolyse Gesellschaft, the first of their kind in Germany, are given in the *Electrical Review*. Blende, after drying by steam, is "grilled" in a battery of four Humboldt nine-stage furnaces, each capable of dealing with 60 tons of blende per twenty-four hours. The resulting vapours are passed through an electrical purifier and through cooling towers, where they make contact with sulphuric acid. The products of the blende grilling process are stated to result in about 70 per cent. of zinc, which is subjected in solution form to electrolytic treatment in two sets of 240 lead-lined baths in which the zinc is deposited at the rate of about 590 lb. per twenty-four hours in each bath, the total daily output of the 480 baths being about 120 tons. The recovered zinc, which is stated to be 99·99 per cent. pure, is then melted in 20-ton electric furnaces at the rate of 3 tons per hour and cast into 42-lb. ingots.

AN instrument known as the "Coordimeter" has been developed by a Swiss firm for measuring deflections of tall structures, such as buildings or dams. The instrument automatically measures the horizontal movement of a plumb line attached to the structure at a considerable height above the instrument. By using a number of plumb lines attached at different elevations, change in shape of the axis of the structure can be accurately determined. Corrections for temperature variations between the time of beginning an observation and completing it must be made, but otherwise the instrument is completely automatic. One of these instruments, described in *Engineering News-Record*, has a range of 30 mm. and an accuracy of reading of 0·05 mm. The dial plates are supplied with metric or inch divisions. With some practice the readings can be made with a precision of 0·1 mm. or 0·004in. "Coordimeters" can be built in such a way as to transfer the readings to a central station. For example, the indicator might be placed in a turbine-house so that the deflection of the top of a dam can be observed at the same time as the height of the water level.

TO ascertain the relative life of Carboloy (cemented carbide) under conditions of extreme abrasive wear some interesting tests were carried out by the Carboloy Company, of Detroit, and the tests are described in *Machinery*. Five bars were tested; one made from Carboloy, one from chromium-plated steel, one from nitrided steel, one from bronze, and one from steel having a hardness of 65 Rockwell C. The chromium-plated bar was plated to a depth of 0·010in. on each side. The nitrided steel, 950 to 1050 Vickers B.H., was hardened to a depth of 0·020in. on each side. The bronze bar had a hardness of 32 Rockwell C. The steel bar had a hardness of 65 Rockwell C, and the Carboloy bar 92·5 Rockwell A. The method of testing was as follows:—The five bars were blasted continuously, using No. 72 steel shot at 100 lb. pressure. This test was continued for forty minutes. After twenty-four minutes the chromium-plated bar was completely severed; the nitrided bar was worn through after 23½ minutes; the bronze bar lasted 11¼ minutes; the 65 Rockwell C steel bar stood up for forty minutes without being severed, but about 50 per cent. of its thickness was worn away. The Carboloy bar showed no appreciable wear, although its surface finish was slightly dulled.

CONVENTIONAL inspection methods for high-pressure equipment consist largely of tapping the sides of equipment with a light hammer during periods of shut-down to detect areas worn thin, and of boring holes at suspected points to determine the thickness of the piping or other equipment. The *Industrial Bulletin* describes a simple method which gives warning in advance of impending failure of high-pressure equipment. This method, which is known as the de Florez safety drilling method, supplements the usual type of check by drilling the walls of the equipment with small holes, at fairly close and carefully determined intervals, to the depth of the lowest safe thickness limit. When corrosion occurs and thins the wall at this point, leakage is evidenced by a thin trickle through one or more of the small holes present at the worn section. By this means local failure occurs harmlessly and warningly while the wall as a whole is still strong enough to withstand general failure and to permit operation to continue with safety until such time as the plant may be shut down. The safety holes are conically tipped so the trickle increases as wear continues, and any obstruction which might otherwise interfere with leakage is dislodged. To prevent corrosion of the holes when the exterior of the equipment is subject to corrosive conditions, the holes may be plugged up with some material which will blow out or permit the contents of the equipment to pass should failure occur. The amount of metal removed by safety drilling is so small that the drilling is reported not to impair the strength of the equipment drilled, as has apparently been proved conclusively by bursting tests.

Air and Water.

WORK has started on the construction of Royal Air Force stations at Waddington, Lincolnshire, and at Tern Hill, Salop. The cost of these two stations is about £600,000.

WITH the object of relieving some of the unemployment among Sunderland's shipyard workers, Lord Runciman has ordered a second 9200-ton motor cargo vessel on his personal account.

FOR the fourth year in succession the Society of British Aircraft Constructors is to give a flying display and exhibition at Hendon of all classes of civil and military aeroplanes. The display will be held on July 1st after the R.A.F. Pageant on June 29th.

IT is announced that the new Chairman of the Society of British Aircraft Constructors is Sir Robert McLean. Mr. Hugh Burroughes has been re-elected Deputy Chairman (aircraft), and Air Vice-Marshal A. E. Borton elected Deputy Chairman (engines). Mr. John Lord has again been elected to the post of Treasurer.

FOUNDERS' DAY at the Devitt and Moore Nautical College, Pangbourne, took place on Friday, May 31st. There was a large gathering of friends, and an address was given and the prizes were presented by the Admiral Commanding Reserves, Vice-Admiral George K. Chetwode, and Mrs. Chetwode. In presenting his annual report, Captain Tracy said that this year a larger number of cadets than before had entered the College.

ON Monday, June 3rd, over seventy members and friends of the Engineers' German Circle paid a visit to the Heston airport. They were received by Mr. Malone, who conducted the party through the hangars and workshops. Attention was drawn to the new floodlighting arrangements. Short flights were made in a de Havilland "86" fourteen-seater express aeroplane, and dinner was served in the Airport Restaurant. A very interesting evening was spent.

ON Thursday, May 30th, we were invited to inspect the "Empress of Britain" in dry dock at Southampton. The vessel returned to that port on May 28th from her fourth successive round-the-world cruise, having travelled a total distance of 37,500 miles, at an average speed of approximately 18·5 knots. On the cruise and on the Atlantic passages to and from New York she was operated as a twin-screw vessel, her outer propellers having been removed prior to leaving Southampton. That arrangement has again proved to be most economical in fuel consumption, while the use of one funnel only conduced to a clean ship. The vessel was, at the time of our visit, in dry dock to receive her outer propellers and a new pair of inner propellers. She begins her 1935 Atlantic season on Saturday, June 8th. We were impressed by the well-kept clean engine-room and by the fact that after such a long voyage no repairs or renewals were necessary other than a few routine replacements of boiler brickwork.

THE "Gneisenau," the second of the Norddeutscher Lloyd Company's three express liners for its Far East services, recently launched at the Deschimag Yard, Bremen, is an 18,000-ton ship with a Maierform hull, and will be propelled by geared turbine machinery. Her sister ship, the "Scharnhorst," is propelled by A.E.G. turbo-electric machinery with Wagner-Deschimag water-tube boilers, and is now on her maiden voyage to the Far East. She is equipped with two 10,000-kW A.E.G. turbo-generators running at 3120 r.p.m., which supply 3120-volt A.C. to the two 13,000 h.p. propelling motors. The water-tube boilers are four in number and each has a heating surface of 650 square metres. Steam is supplied to the turbines at a pressure of 710 lb. per square inch and a temperature of about 880 deg. Fah. The auxiliary machinery includes four 220-volt D.C. turbo-generator sets. The ship, after undergoing successful trials, left with a full complement of 120 first-class and 150 tourist-class passengers. The third liner, the "Potsdam," which is being built to Hamburg-America Line account by Blohm and Voss, at Hamburg, will be engined with Siemens-Schuckert turbo-electric machinery and high-pressure Benson boilers. She is to make her maiden voyage early in July. The competitive performances of these three high-speed liners with varied hull and propelling machinery equipments will be watched with interest by all marine engineers.

THE development work pursued by the Bristol Company during 1934 upon the sleeve valve type of air-cooled radial engine resulted in the completion in October, 1934, of a successful official 100 hours' type test upon the civil-rated "Perseus II" engine. At the conclusion of this test an equally successful repeat type test was carried out on the same engine. The civil series of "Perseus II" engine is rated as follows:—Power at normal r.p.m., 640–665 at 2200 r.p.m.; power at maximum r.p.m., 740–770 at 2525 r.p.m.; take-off power, 640/665 at 2200 r.p.m.; weight, 1026 lb. In addition to the duplicated 100-hour type tests, it was decided by the Air Ministry to carry out a long-endurance test under economical cruising conditions before putting this series of engine into service for civil use. Accordingly, a standard "Perseus II" engine was submitted to a 250 hours' weak mixture cruising test. The engine was run consistently on a hangar stand for twenty-three ten-hour periods comprising thirty minutes at 665 b.h.p. (2200 r.p.m.) and nine and a-half hours at 420 b.h.p. (2150 r.p.m.). Two further ten-hour runs, each consisting of nine and a-half hours under cruising conditions and thirty minutes under climbing conditions, were carried out on a dynamometer. The average fuel and oil consumptions were 0·467 pint per b.h.p. per hour and 7·35 pints per hour respectively. Beyond the routine examination and servicing of sparking plugs approximately every ten hours no adjustments or maintenance work of any sort was carried out, and when stripped for examination at the end of the test the engine was found to be in excellent condition. A production series of the civil-rated "Perseus II" engine will be commenced in the autumn of 1935, and all engines will be available for use with the Hamilton controllable pitch airscrew. Four engines of this type have already been delivered to Imperial Airways, Ltd., for installation in a Short "Scylla" machine.

THE NICKEL ALLOY WORKS OF HENRY WIGGIN AND CO., LTD., BIRMINGHAM

(For description see page 592.)

ABOVE:—ELECTRIC FURNACE FOR NICKEL ALLOYS
BELOW:—NICKEL ALLOY ROD ROLLING MILL

ABOVE:—NICKEL ANODE CASTING SHOP
BELOW:—SPOON AND FORK STAMPING DEPARTMENT

The Engineer

JUNE 7, 1935.

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Contents.

THE ENGINEER, June 7th, 1935. PAGE

A SEVEN-DAY JOURNAL ... 581
KING GEORGE V GRAVING DOCK: PUMPING PLANT AND EQUIPMENT. No. I. (Illus.) ... 583
RAIL WELDING ON AMERICAN RAILWAYS. (Illus.) ... 585
BRITISH STANDARDS INSTITUTION ... 586
THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM. No. IV. (Illus.) ... 587
INSTITUTION OF MECHANICAL ENGINEERS: BATH SUMMER MEETING. No. II ... 590
THE NATIONAL ELECTRICAL CONVENTION. No. I. ... 591
A BIRMINGHAM NICKEL ALLOY WORKS. (Illus.) ... 592
ELECTRICAL FACTORY EXTENSIONS AT PRESCOT ... 592
RAIL AND ROAD—MISCELLANEA—AIR AND WATER ... 593
LEADING ARTICLES—
The Welding of Rails ... 595
Constructional Engineers and Steel Makers ... 595
C.G.T. LINER "NORMANDIE." No. II. (Illus.) ... 596
OBITUARY—D. N. Dunlop ... 598
SYMPOSIUM ON THE WELDING OF IRON AND STEEL. No. IV ... 599
LETTERS TO THE EDITOR—
Grid Trading ... 600
Social Credit—Shortage of Skilled Labour ... 601
MULTIPLE ARC WELDING EQUIPMENT. (Illus.) ... 601
A PORTABLE EARTH TESTER. (Illus.) ... 602
LAUNCHES AND TRIAL TRIPS ... 602
CONTRACTS AND ORDERS ... 602
RUNNING DEFECTS AND FAILURES OF CENTRIFUGAL PUMPS. (Illus.) ... 603
TECHNOLOGICAL ACHIEVEMENTS ... 604
MARKETS, NOTES AND NEWS ... 605
CURRENT PRICES FOR METALS AND FUELS ... 606
FRENCH ENGINEERING NOTES ... 607
BRITISH PATENT SPECIFICATIONS. (Illus.) ... 607
FORTHCOMING ENGAGEMENTS ... 608
THE INSTITUTE OF BRITISH FOUNDRYMEN ... 608
PERSONAL AND BUSINESS ANNOUNCEMENTS ... 608

NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

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**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS.

**** Will subscribers please note that in all advices of this kind it is necessary to have* **both the old and new addresses,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Social Credit.

We have pleasure in announcing that, in response to the request of several readers and in view of the interest shown by our correspondents, we shall print in our next and succeeding number articles on the Douglas Social Credit scheme written expressly for THE ENGINEER *by an eminent and independent economist.*

The author is Dr. W. H. Coates, LL.B., B.Sc., Ph.D., a Director of Imperial Chemical Industries, Ltd., Dr. Coates graduated at the University of London with First Class Honours in the Faculty of Economics and Political Science; was Director of Statistics and Intelligence, Inland Revenue Department, between 1919 and 1925; and Secretary to the Treasury Committee on Departmental Contracts, 1916–1920. For some years he was examiner in Economics to the University of London, and (jointly with Sir Josiah Stamp) in Economics and Statistics to the Society of Incorporated Accountants and Auditors. He is the author of several publications on Taxation.

THE WELDING OF RAILS.

WHILST accidents resulting from the dislocation of railway tracks by the expansion of the rails under rising temperature are rare, there is probably no exposed railway which has not at some time or another suffered from such mishaps, but on the main lines of this country there have been only five derailments from this cause in thirty-four years. Provision against the inevitable lengthening of a rail by heat is made by leaving the familiar gap between the ends of the rails, and, in some cases at least, by greasing the fish-plates and bolts. The dimension of the gap varies, of course, with the period of the year, the time of the day, the state of the weather, and the length of the individual metals. But be it long or short—some $\frac{3}{8}$in. to $\frac{1}{2}$in. in this country—it is always objectionable. Not only does it give rise to the familiar rhythm of trains, and apparently originate corrugation, but it is the point at which maximum wear takes place, and forms, therefore, the principal item in rail maintenance. It has not been neglected here, and for at least five years has been under the careful consideration of British railway engineers; but greater efforts have been made abroad to overcome it by welding the joints either in the rail shops or on site. Each of these plans has its proper defects. If shop welding is adopted the maximum length is controlled by the difficulties of transport and handling. If welding on site be adopted, the cost is considerably greater and the economies may disappear. It was estimated in Germany in 1933 that thermit rail welds made in the shops cost 25s. to 30s. each, and if made on the track about £2. Electric welding would be much cheaper, but is not always practicable, and, as an article which we print elsewhere in this issue shows, has made relatively little progress even in America.

Regarded logically the welding of rails into great continuous lengths is a hopeless and dangerous proposition. Even with the moderate climatic conditions of this country, with a working temperature range of some 100 deg. Fah. or so, a continuous rail 1000ft. long should, by calculation, increase its length by over 7in. Yet, on the Saar section of the German railways there are continuous welded stretches of 480 m.—over 1500ft.—and parts of the Delaware and Hudson railway are welded into unbroken lengths of 2800ft. Why is this possible? The fact appears to be that a long rail does not expand as much as calculation shows it should do. In a paper by Messrs. Rietsch and Croskell at the recent Welding Symposium, the authors said: "It has been found that longer lengths have not the same proportional expansion and contraction as have shorter rails, the actual difference in length never equalling the theoretical difference, possibly due to expansion in all directions." These two authors are interested in the development of electric welding, and, in consequence, their testimony might be questioned were it not borne out by experience and by the conclusions of others. Thus W. L. Webb, in his "Railroad Construction," remarks, after detailing the expansion that should take place: "But it is doubtful whether there would ever be such a range of motion even if there were such a range of temperature (160 deg. Fah.)." Cole, in his "Permanent Way," says: "It was found, however, on the old London and North-Western Railway, that 60ft. rails do not expand proportionally more than 30ft. rails." He adds that "French railways do not allow expansion in exact proportion to length of rail." The explanation offered by some is that the rail is in a state of local compression between the supports, whilst others suggest that the expansion is accommodated by slight vertical bendings, generally downwards, of the rail. Moreover, it is not often that 1000ft. of rail in temperate latitudes would reach the same high temperature throughout its length. Ordinarily, there are countervailing influences, such as shadows, draughts, the presence of local water, and so on, all tending to check a general and equal rise of temperature. In every one of the five cases of derailment from rail distortion mentioned in our opening paragraph, a hot sun, and not a rise in the air temperature, was given as the cause. This fact suggests, at any rate, that unequal heating of the rail, possibly on one side, may have been as much responsible for the distortion as general extension.

A fair number of scientific investigations into the expansion of rails in service have been made, but still more are needed. In the opinion of some engineers bull-headed rails are less suitable in all respects for welding in great lengths than flat-bottomed rails. We believe that a test now being made on a British railway will settle that question. But even if the conclusion be entirely favourable it will not, we fear, lead us far in the face of the economic conditions. It is on those conditions rather than on technical problems that welding fails, and until some cheaper method than thermit welding for rails on site is available, we are not likely to see that practice adopted, even on tube railways, which are not troubled by the temperature problem. We are well aware that portable plant for the electric butt welding of rails is being made, and that it has been shown to be satisfactory and cheap; but a good deal remains to be done before welding by it will be as economical as the "gap." Yet there are such manifest advantages, in the reduction of maintenance and the increase of quiet and smooth running, that the complete solution, both technically and economically of the problems of continuous rails, must eventually be reached. Welding is already very largely used all over the world for repairing rails in the track, and considerable experience has been gained in the butt welding of rails into considerable lengths, up to nearly 300ft. in Germany, in the shop. In that country there is, in the Brandleite Tunnel, between Berlin and Stuttgart, continuous welded track 8662ft. 6in. in length. Such facts as these point to the ultimate solution of the problems. Difficulties and obstacles there are, and we do not for one moment suggest precipitate action. It is not improbable that the first important development will be made in tube railways, mainly in obedience to the ever-increasing public desire for the decrease of noise.

Constructional Engineers and Steel Makers.

THERE have been occasions in the past when the business relations of the constructional engineering firms and the steel manufacturers have not been of the happiest, and it is perhaps one of the best aspects of the reorganisation scheme that it has brought about a change in this respect. For years past a number of outstanding questions have divided the two industries which in practice are so dependent upon each other. When, in 1927, the steel makers introduced their Rebate Scheme, whereby those constructional firms buying only British steel received substantial rebates, a step was made towards bringing about a closer understanding. The original terms were later on increased, and eventually provided for rebates on British joists of 22s. 6d., and on sections of 15s. per ton, so that it can be readily understood that a number of firms found it paid them to join with the steel makers rather than maintain their independence and to buy in the Continental market. The introduction of this scheme coincided with a movement on the part of municipalities and other big customers of the constructional engineers, which has steadily grown, to insist upon the use of British material in their undertakings. During the days of the depression, however, the engineers claimed that some of the benefit they should have received from the rebates was lost through the steel makers cutting their fixed prices to competitors outside the scheme in their anxiety to obtain business. An even greater cause of dissatisfaction arose when allegations were made that steel companies possessing fabricating yards and some constructional engineering firms allied to steel makers, took important contracts at very low prices. Their competitors declared that they either did not charge fair prices for the fabricating and machining carried out on the steel, or that the steel was supplied at ridiculously low figures. About four years ago negotiations were opened between the constructional engineers and the steel makers in an effort to adjust their differences, but little good came of these discussions, and the situation remained unsatisfactory until the steel makers' reorganisation scheme took shape.

From the point of view of the constructional engineers some of the provisions of the steel makers' reorganisation plan offered a way of escape from a situation which some at least were finding intolerable. The proposals for tightening up the steel makers' fixed price arrangements promised protection from an irritating practice which every constructional firm believed to be widespread, although, naturally, such breaches of the agreement were difficult to prove. The system of interlocking rebates which is one of the principal features of the reorganisation scheme, although it admittedly had several defects, did in the estimation of many engineers, provide a solution to one of their major difficulties. If the steel makers strictly observed their own fixed prices and granted rebates only to the structural engineering firms which belonged to associations affiliated to the British Iron and Steel Federation, the danger of price cutting on constructional jobs was largely removed. But before the position could be safeguarded in that way it was necessary to secure a greater degree of cohesion in the engineering industry, and efforts were made to bring in all those who were outside the association movement. This, in itself, presented difficulties, since many firms were reluctant to bind themselves for any lengthy period whilst others had given up hope of reaching a satisfactory and permanent arrangement with the heavy steel makers. Discussions regarding quotas and fixed prices for working-up steel also created difficulties, and it was not until a comparatively recent date that something approaching solidarity was achieved. With the formation of an Association of Scottish constructional engineers prospects improved, and it is now claimed that approximately 95 per cent. of the industry belongs to associations of constructional engineers. The next step was to agree upon a scheme of fixed prices for construc-

tional work, and eventually one was reached by the associated firms and is now in operation. The position, however, is not entirely satisfactory, and negotiations regarding the position of the steel companies doing their own fabricating, and engineering concerns allied to steel makers are being continued. At the same time, some important firms remain outside the association movement, and lately steel makers in the Federation have attempted to exercise pressure of the kind to which users of iron and steel have become familiar. Whether satisfactory recruits can be obtained in this way may be questioned, but there is no doubt that the great majority of the constructional engineering firms are heartily sick of price cutting and would welcome a period of price stability, no matter how it was obtained.

The position of the associated engineering firms has been greatly strengthened by the high tariff upon imported steel, whilst the difficulty of placing orders for Continental steel in this country, since the signing of the Anglo-Continental steel pact, has forced a number of the independent firms to rely more upon British steel. The prospects of an extension of the present temporary agreement between the British and Continental makers, combined with the threat that unassociated firms will not be supplied with their raw materials on such favourable terms as the associated concerns, must have a further tendency to reduce the number of outsiders and to strengthen the fixed price arrangement of the engineering industry. Naturally, such methods of obtaining adherence are not popular, and it would be far better to secure unanimity in other ways. There is no gainsaying the fact, however, that most engineers feel that they are entitled to demand loyalty to the fixed price scheme. It is unfortunate that an unnecessary secrecy has been observed with regard to the proceedings which have led up to the present situation. The support of the constructional engineers' important customers, such as municipalities and other public bodies, is more likely to be obtained in these days for a scheme which promises stability in a great national industry if its general outline is common property. Just as there is no secrecy about the steel makers' fixed prices, so the constructional engineers would find greater sympathy with their efforts to maintain a fair price level if the position were plainly discussed. After all, one of the chief objects of a scheme of fixed prices is to create recognised market values.

Compagnie Generale Transatlantique Liner "Normandie."

No. II.

(Continued from page 564, May 31st.)

IN our last article we dealt with the preliminary designs and model tests which preceded the laying down of the "Normandie," and gave particulars of the hull and propelling machinery, referring principally to new features in the design of hull adopted. A view of the ship running about 18 knots is reproduced in Fig. 6.

WATER-TIGHT SUBDIVISION.

As regards the safety of the vessel, the measures adopted for water-tight subdivision, fire protection, and the safe navigation of the ship, more than meet the requirements of the International Conference for Safety of Life at Sea of 1929. The cellular double bottom of the hull forms the water ballast compartments, and is divided into forty sections. The double hull, which extends over the entire length of both engine and boiler rooms, is divided into sixty-two sections. Besides these compartments, there are eleven main transverse bulkheads, which are extended right up to the water-tight decks, C deck aft and B deck forward. The several bulkheads carry thirty-two hydraulically operated and twenty-nine hand-operated doors of the Conard pattern. The doors, which were made by Forges de Saint-Nazaire, were designed under the supervision of J. Stone and Co., Ltd., of Deptford, which firm supplied the closing and indicating mechanisms for the doors. The main pumping unit for the doors comprises two 10 b.h.p. motor-driven oil pumps, each with an output of 40 litres per minute. These pumps discharge into four accumulators in which an initial pressure of about 28 kilos. per square centimetre is obtained by a small air compressor worked by an electric motor. The accumulators are designed to give a full working pressure under liquid load of 52 kilos. per square centimetre. Emergency hand-operated pumps are also provided. The pumping equipment can also be utilised to close the outlets to and from the sewage system, which are hydraulically operated and are placed on the skin of the ship.

The ballast pumping and draining equipment is in full accordance with London Convention requirements. The pumping out of water ballast and the various hull compartments is performed by two groups of Drysdale Centrex vertical pumps, which are motor driven and are equipped with automatic electric starters. The pumps were built by the Chantiers de la Loire, and are driven by Alsthom motors. They have a designed duty of 500 cubic metres per hour, with a suction height of 5 m. and a delivery pressure of 2 kilos. per square centimetre. The pumps run at 1100 to 1500 r.p.m. For draining, three similar groups of pumps are provided, with an hourly output of 300 cubic metres, and for this service a Drysdale Centrex underwater pump is also fitted. In the engine room compartments provision is made for the circulating pumps of the turbo-alternator condensers to deal with loose water in the engine or motor rooms. A further safety provision is a luminous panel indicating the opening or closing of portholes.

FIRE PROTECTION.

The fire protection measures are far in excess of the London Convention requirements, and have been adopted after careful study and experiment. The scheme adopted embraces the following principal points as regards fire protection and fire-fighting measures :—

Fire Protection and Fire Fighting.—(1) The provision of a network of bulkheading sufficiently compact and conveniently located, which will permit fire to be confined for an appreciable time to the smallest possible space to facilitate the evacuation of passengers as well as to permit rapid access of the firemen's squad and their equipment.

(2) The use of non-combustible elements, in so far as their use does not radically affect the usual construction procedure nor have any detrimental effect on habitability or decoration. In any case, the use of any material which could in burning or by distillation emit dense smoke, toxic gases, or vapour has been entirely dispensed with.

(3) The design and the lay-out of the electrical and ventilation systems throughout the entire ship, with a view to ensuring definitely that these two systems will not be the cause or a means for the propagation of fire.

(4) Continual vigilance and the use of control and detection equipment, with its signals centralised in a single room fitted with the necessary means of communication to bring instant assistance.

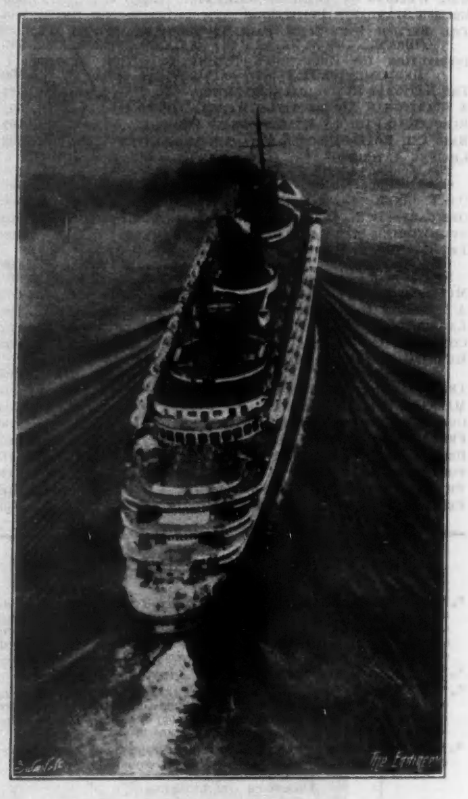


FIG. 6—THE SHIP AT 18 KNOTS

(5) The use of powerful means of extinction which can be brought into action rapidly and effectively by trained, experienced, and disciplined *personnel*.

(6) The lay-out of the entire ship in such a way that the normal life can be continued in the unaffected regions of the ship without these suffering any discomfort or damage, and that the attacked parts can be kept in use up to the last moment in order to enable the easy movement of passengers and those engaged in the extinction of the fire.

The sketch drawings we reproduce in Fig. 5 show clearly the arrangement adopted. The three main water-tight bulkheads have been extended upwards to the promenade deck as fireproof bulkheads, dividing the entire ship into four main sections. These bulkheads have been designed to withstand fire for practically any length of time, and are thoroughly insulated on both sides. In each of these sections the accommodation is divided by secondary fireproof bulkheads capable of withstanding 1500 deg. Fah. for one hour. The spacing of the bulkheads is such that the area of the compartments is, on the average, less than 4300 square feet, representing about six cabins, thus forming a cell, where a fire can rage for an hour

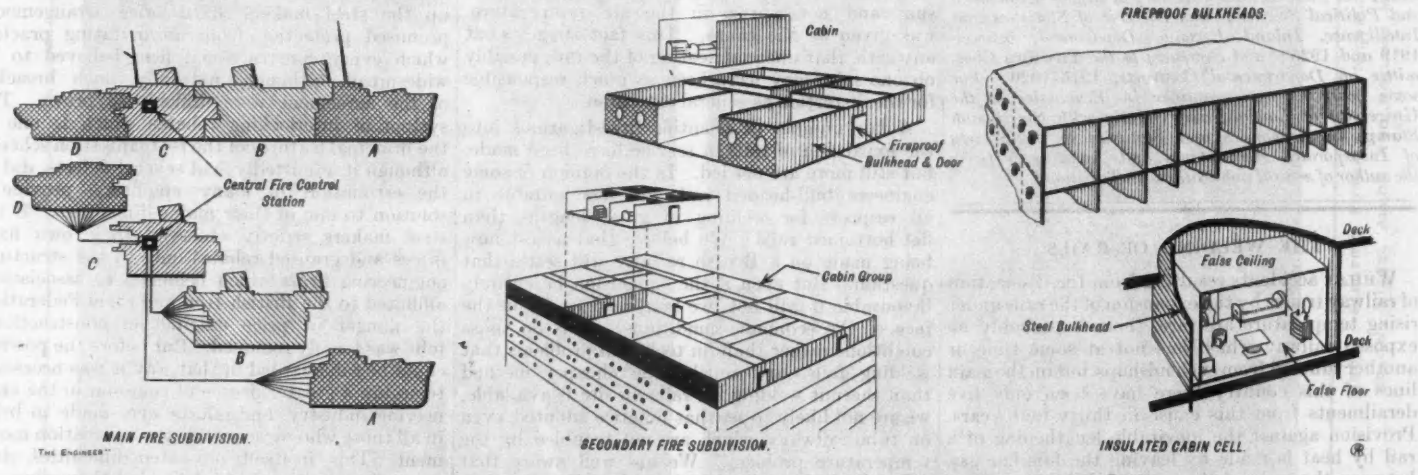


FIG. 5—DIAGRAMS ILLUSTRATING THE FIRE PROTECTION BULKHEAD SUBDIVISION OF THE SHIP

without any possibility of spreading further, the decks being insulated to prevent the extension of fire by conductivity through the steel plating. All spaces behind such partitions or above ceilings are absolutely sealed and air-tight, and no electric wiring passes through them.

As will be seen from Fig. 7, the wiring is laid carefully in insulated and fireproof channels, giving easy access for inspection and with many ventilation holes

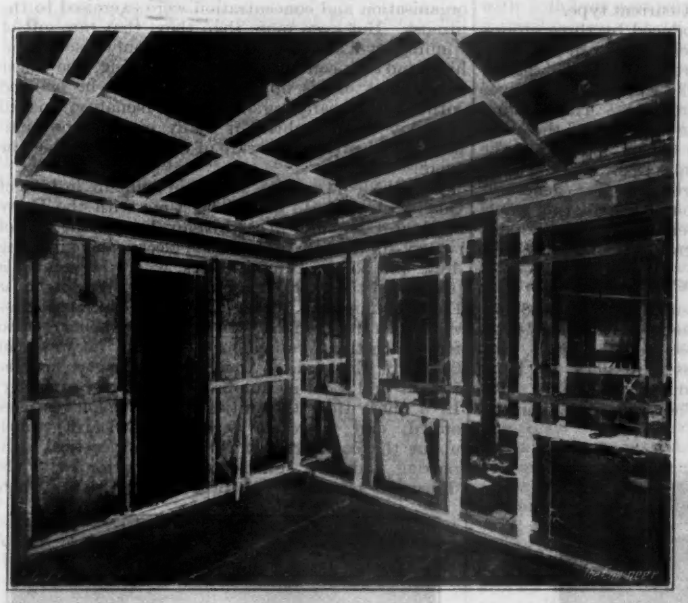


FIG. 7—GENERAL CONSTRUCTION OF CABIN SPACES

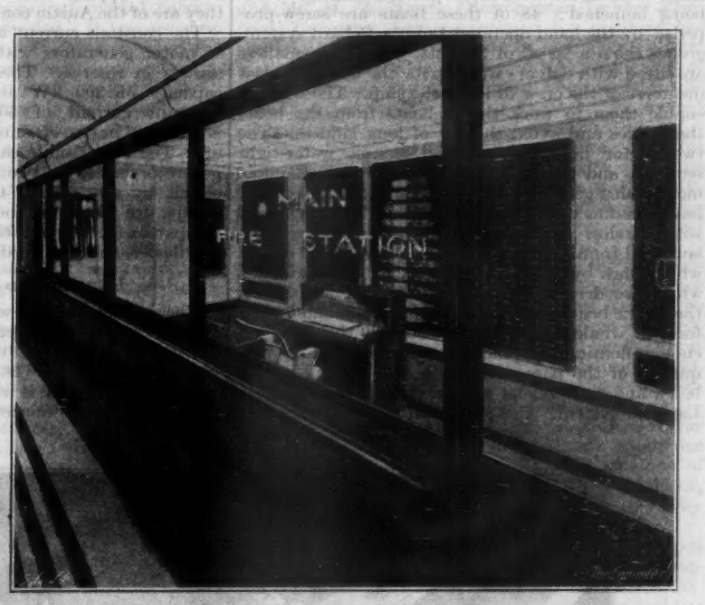


FIG. 8—CENTRAL FIRE CONTROL STATION

to prevent overheating; these give at the same time a free outlet to any gases generated, and should make for the easy instant detection of any trouble. The electric circuit of each of the four main sections is entirely independent of the others, so that if any trouble arises in one of them the ordinary routine of the vessel will remain unaffected in the others. Provision is made to bring emergency current for lighting and power to any crippled section.

The ventilation, like the electricity supply, is grouped independently, and in each of the four sections of the ship quick-closing shutters are provided at each intersection of the fireproof bulkheads. In the construction of the cabin work the minimum quantity of wood has been used. All the decks are of steel, and they are covered either with special insulating material or fireproof rubber. Compressed

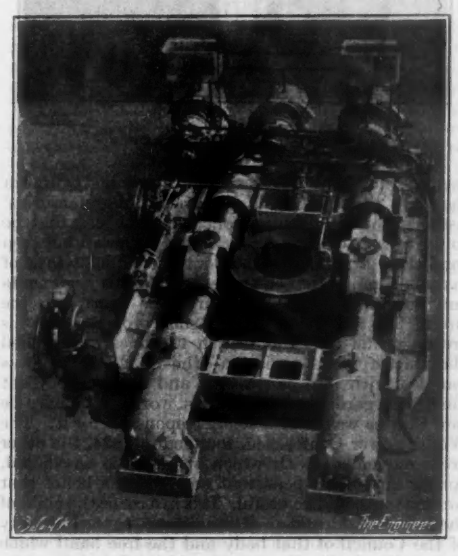


FIG. 9—STEERING GEAR

cork slabs fixed with a special glue to the plates, which are only given one coat of lead oxide, are used, and they have shown resistance to a temperature of over 1000 deg. Fah. over a considerable time without emitting gas or smoke.

In the public rooms only metal or mineral materials, such as steel, glass, marble, or stone, are used, and in special cases where wood groundings or finishes are needed, protection against fire is effected by fireproof paint, or by asbestos sheeting, which is a component of all the plywood employed.

In Fig. 8 we illustrate the central fire station, which is situated aft on D deck amidships. This station is equipped with complete indicator boards and a special telephone exchange enabling the officer on watch to be in constant touch with the patrol squad. This force is under the direct control of a safety officer, and comprises a squad of trained firemen with two petty officers and over forty sailors, who, in normal times, are entrusted with the work of patrolling the ship under the captain's orders. Three special men are detailed to deal with the electrical equipment.

For the detection of fire in accommodation spaces, over 1070 automatic electric detectors have been fitted in cabins. They are brought into operation by any abnormal rise in temperature, and show their working by a lamp on a panel in the alleyway adjoining the cabin, and also by a light on the main fire control board, which indicates the number of the section. There are, in addition, 224 fire alarms, one in each cabin group, which are connected with the main fire control station, and serve to indicate the position of the fire, thereby enabling the ventilation and electricity supply to that section to be immediately controlled. In the holds, store rooms, and other more or less inaccessible spaces, visible smoke indicators are installed, and also acoustic alarm signals worked by means of a light cell.

The fire-extinguishing equipment includes three sets of fire pumps, working at 10 kilos. pressure, two groups in the turbo-alternator room, and one in No. 2 boiler room. They have an output of 300 tons per hour, and are driven by a 159 h.p. motor running at 1100 r.p.m. The distributing mains supply 504 fire hydrants, 422 of which are mounted in 211 fire-fighting lockers, complete with twin hydrants and an ample supply of fire hose, &c. In the passenger accommodation there are 1326 manholes provided in the ceilings of cabins so that water can be injected into the cabin space by means of a special swivelling nozzle.

There are ample supplies of CO_2 gas for fire fighting in holds, there being no less than ninety bottles, each containing 25 kilos. of CO_2. These supply two valve houses, one of which is connected with the thirteen stations in the forward section of the ship, and the other with seven stations in the after part of the ship. The piping has been so dimensioned that in 105 seconds the largest space can be saturated up to 30 per cent. For fighting oil fires there are several carbonic foam plants, both fixed and transportable; and, for general use, more than 200 small portable fire extinguishers. The fire-fighting crew of the ship is quartered in close proximity to the central fire station, where full fire-fighting equipment is maintained. It may be said that in no other ship afloat has the fire-fighting problem been given such careful attention.

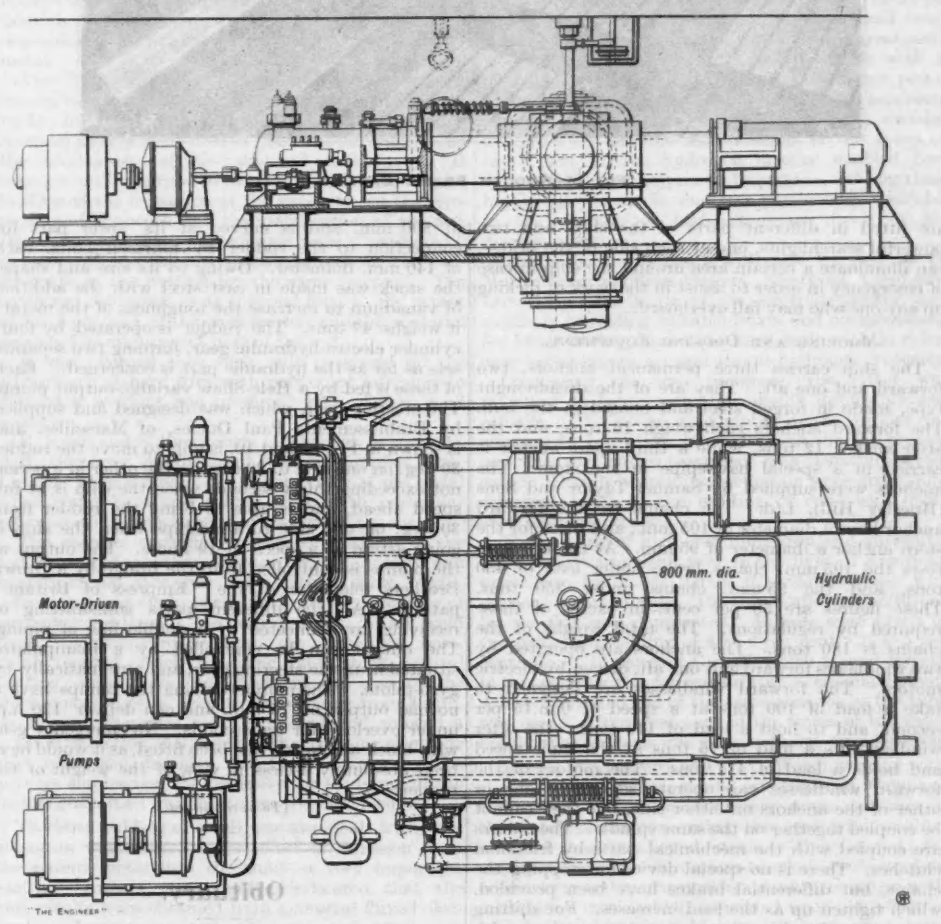


FIG. 10—GENERAL ARRANGEMENT OF STEERING GEAR

LIFE-SAVING EQUIPMENT.

The "Normandie" is equipped with 26 lifeboats, with a carrying capacity of 88 passengers each;

22 smaller ones, with a capacity of 46 each; two motor boats to take 32 passengers each, and 2 whale boats, with 25 places each. The total carrying capacity is 3582 persons, which is 8 per cent. in excess of the full complement of the ship. All the boats, the sample boat of which was supplied by Hugh McLean and Sons, of Govan, Glasgow, are classed A I, and are built of wood, with a double mahogany skin having a waterproof fabric between. They are fitted with Schat skates to prevent damage when being launched; 48 of these boats are screw-propelled by the hand-operated Lutetia-Echard system, giving them a speed of 3 knots. The four smallest are fitted with Salvare winches for the use of the last members of the crew to leave the ship. The winches enable them to work the lifeboats from the boats themselves and avoid the use of long ladders. The two motor boats are divided in six water-tight sections, and are propelled by a 75 h.p. Baudoin motor using gas-oil. Their speed is 9 knots, and they have a radius of action of 100 miles. They are fitted with wireless and searchlights. All the boats are launched from Welin-McLachlan gravity-type davits, which work by twelve double and six single winches, which are driven by electric motors of 30 h.p. for the motor boats, 20 h.p. for the lifeboats, and 7½ h.p. for the whaleboats. In addition to the lifeboats, enough floating equipment is provided to carry one-quarter of the passengers on board, as well as lifebelts, and six lifebelts with electrical release on the Lavallée system. For giving an alarm 104 klaxons are fitted in different parts of the ship, and two powerful searchlights, one at each side of the bridge, can illuminate a certain area around the ship in case of emergency in order to assist in the work of picking up any one who may fall overboard.

Mooring and Docking Equipment.

The ship carries three permanent anchors, two forward and one aft. They are of the dreadnought type, made in forged steel and housed in the hull. The forward anchors each weigh 16 tons, and the after anchor 12 tons, while a third spare anchor is carried in a special hawsepipe in the stem. The anchors were supplied by Samuel Taylor and Sons (Brierley Hill), Ltd. The chains for the forward anchor have a diameter of 105 mm., and those for the stern anchor a diameter of 95 mm. At the breaking tests the 105 mm. chains broke under load of 450 tons, and the 95 mm. chains under 350 tons. These figures are 50 per cent. in excess of those required by regulations. The total weight of the chains is 180 tons. The anchors are operated by two windlasses forward and one aft, driven by electric motors. The forward windlasses are designed to take a load of 100 tons at a speed of 0 m.15 per second, and to hold a load of 140 tons; the after windlass lifts a load of 76 tons at the same speed and holds a load of 414 tons. The motors of the forward windlasses can operate separately one or other of the anchors on either side, but they cannot be coupled together on the same spindle. The motors are coupled with the mechanical parts by frictional clutches. There is no special device for stopping the chains, but differential brakes have been provided, which tighten up as the load increases. For shifting or warping the ship, there are seven capstans with barrels keyed on to their spindle, and four capstans with free barrels. Each is able to hold a load of 32 tons and to lift a load of 30 tons at a speed of 0 m.20 per second without the help of any mechanical apparatus, and to haul in ropes without load at a speed of 1 m.20 per second. One of these capstans is fitted to take in buoy chains. Moreover, the aft windlass is fitted with a barrel, which enables it to be used in the various manœuvres of warping and shifting if required. The windlasses and capstans have been grouped in such a way that a single motor can drive two of them. With that object in view two mooring and warping capstans are combined with the windlasses, and the lay-out is such that any motor can drive one of the capstans, the other being used meantime for operating any of the anchor chains. The after windlass is connected to another capstan in the same manner. All the motors are of the same type and are built with the object of suppressing a sudden demand for current and to allow of stopping under load without a time limit; they are of the Austin constant-current type.

The constant current is produced by three groups of motor generators with exciters, one of which is always in reserve. These groups have a designed capacity of 300 kW at 1000 r.p.m., and deliver constant current of 500 ampères. The feeding is arranged in two circuits, one forward and the other aft. The two circuits can be fed by any one of the generator units, by two groups, or by feeding each circuit by any one of the groups. The generator groups are placed in the general distributing panel compartment. The total weight of the capstans, windlasses, and their feeding groups is about 290 tons.

Rudder and Steering Gear.

The rudder, which was supplied by the Skoda Works, is of the streamlined, unbalanced type. It has a cast steel carcase covered with steel plates, and weighs 96 tons. A view of it in the makers' works is reproduced in Fig. 11. The area is 45 square metres. The stock has a diameter of 800 mm. and is curved at its lower part for connection to the rudder by fourteen bolts, each of 140 mm. diameter. Owing to its size and shape, the stock was made in cast steel with the addition of vanadium to increase the toughness of the metal; it weighs 47 tons. The rudder is operated by four-cylinder electro-hydraulic gear, forming two separate sets as far as the hydraulic part is concerned. Each of these is fed by a Hele-Shaw variable-output pump. The steering gear, which was designed and supplied by Etablissements Paul Duclos, of Marseilles, and is shown in Figs. 9 and 10, is able to move the rudder 30 deg. on one side to 30 deg. on the other in a period not exceeding thirty seconds when the ship is at full speed ahead, and is able to bring the rudder from 30 deg. on one side to amidships when the ship is going astern at a speed of 19 knots. The output of the pumps is controlled from the bridge by a Brown Brothers telemotor of the "Empress of Britain" pattern. All the different parts transmitting or receiving are connected by a double line of piping. The output can be controlled by a manipulator situated near the steering gear, and automatically by gyro-pilots. The motors driving the pumps have a normal output of 75 h.p., and can deliver 150 h.p. under overload for ten seconds. No emergency gear with block and tackle has been fitted, as it would have been absolutely useless in view of the weight of the rudder.

(To be continued.)

FIG. 11—RUDDER FRAME CASTING

Obituary.

MR. D. N. DUNLOP.

MR. DUNLOP, of the B.E.A.M.A. and the World Power Conference, whose death occurred on May 30th, after an operation, was known to all engineers, principally by his work, but in a large measure by a personality in which strong business instincts were blended with metaphysics almost on the border-line of mysticism. This mental attitude, not rare amongst Scotsmen, caused him to look upon the affairs of men from a very philosophical standpoint, and to regard their errors as manifestations of natural forces over which they had but limited control. Hence he was as patient and tolerant as a scientist pursuing an investigation and recording phenomena. With these qualities and a very wide knowledge of the electrical industry, he was called upon to serve on numerous committees, and without them he would never have succeeded in producing the B.E.A.M.A. from the confused and contending elements with which he had to deal, nor would he have brought to perfection in a few years the World Power Conference. In this work his power of organisation and concentration were exercised to the utmost. But even more than they, that rare gift of winning loyal and devoted support from those around him and of convincing or persuading the most recalcitrant of his opponents. All this he effected without ever parading his own personality, and to this day it is doubtful if many outside the engineering industries are aware of the influence which he exercised.

Daniel Nicol Dunlop was born in Ayrshire in 1868 of Quaker stock. He served his time with the Howe Machine Company, of Ardrossan, but at the age of twenty-six the lure of American electrical engineering drew him to the United States, where he secured a position in the New York offices of the Westinghouse Electric Company. There he made such progress that when the Trafford Park works were being erected for the British Westinghouse Company he was sent back to England as publicity manager for the British and Continental branches of the company. In a short time the duties of sales manager were added, and in that capacity he learnt much about the conditions of the British electrical engineering industry, and observed particularly the disastrous effects of cut-throat competition. There

DANIEL NICOL DUNLOP

was a small and not very influential body known then as the National Electrical Manufacturers' Association, and Dunlop conceived the idea that he could use it to bring about more harmony between conflicting firms. He set about the difficult task of making combination effective, and by his arguments and personality brought many new firms into the circle. By 1911 he had made such progress with his great scheme that the British Electrical and Allied Manufacturers' Association—the B.E.A.M.A.—was founded with him as director and secretary. That must be regarded as his greatest work, for it may be said that he was almost solely responsible for it. The World Power Conference, founded in 1924, the other great movement with which his name is associated, sprang out of his persistent and genuine belief that committees could be useful. It is in a sense the child of the B.E.A.M.A., and owes its existence to the liberality of the Council of that body and the free hand which it gave Dunlop in the pursuit of his schemes.

It cannot often be said of any eminent man that his life's work was done, but we think that it might in the case of Dunlop. He had built up a great twin structure, directed it through its early stages, and seen it reach a degree of perfection at which it could do without his help. It is true that his interests were wide and that he was directly interested in other great movements, but none of them would have ever been so peculiarly his own as the B.E.A.M.A. and the W.P.C.

To overcome the inconvenience caused by the varying flow of the river Indus at different seasons of the year, the Hyderabad (Sind) Municipality is abandoning its pumping station on the banks in favour of an electrically driven pumping set installed on a floating pontoon moored 600ft. from the shore. The delivery side of the pump will be connected to the shore by floating pipes, made flexible by ball-and-socket joints, and the output is estimated at 275,000 gallons per hour.

Symposium on the Welding of Iron and Steel

No. IV.

(*Continued from page 560, May 31st.*)

GROUP III. THE METALLURGY OF WELDING.

DR. T. SWINDEN, who presented the twenty-one papers in this group, first referred to a selection of nine of them, dealing primarily with the metallurgy of arc-welded mild steel. The theme running through these papers was a comparison of bare metal, lightly coated, heavy-flux-coated, and cellulosic-flux-coated rods, with particular reference to the properties of the deposited metal, and especially the gas content. In general, there was fair agreement between the various figures given for oxygen and nitrogen in referring to the deposited metal from similar types of rods and a definite trend of opinion that for the optimum mechanical tests on all weld specimens the FeO and nitrogen contents should be as low as possible. It was suggested by several authors that the best method of achieving that end was by the use of the cellulosic-flux-coated rod.

Dr. L. Reeve (United Steel Companies, Ltd.) had contributed a mass of very valuable data and had indicated the value of the vacuum extraction method for the determination of oxygen in various forms by fractional evacuation. This system undoubtedly warranted very thorough and complete research—which, added Dr. Swinden, the laboratories of the United Steel Companies were preparing to undertake. If further research confirmed the earlier data, they would have a reliable check method on the iodine extraction method with the added advantage that the presence of special elements would not interfere with the results obtained.

In general, the several authors attributed the comparatively poor mechanical properties of bare wire weld metal to a high content of FeO and nitrogen. The importance of differentiating between FeO (at least partly in solution) as such and the oxygen which might be present as other oxides, was stressed. As pointed out by Dr. H. Harris, the form in which the nitrogen was present determined its effect on the properties of the metal. The general effect of oxygen and nitrogen was stated to affect adversely the ductility and impact value. Nitrogen tended to increase the strength, whilst oxygen had the reverse effect; more data on fatigue values would be valuable. Mr. Lincoln gave values of about 5 tons for ordinary bare wire and 14 tons for the shielded arc rod.

Attention was directed in the papers to the effect of oxygen in rendering the deposited metal "hot-short," increasing the tendency to cracking and decreasing the resistance to corrosion.

A paper by Professor A. Portevin and Dr. D. Séférian (France) was devoted to a study of nitrogen, and included a useful, if brief, historical survey and a very valuable study of the Fe-N_2 system, with an appendix on the estimation of nitrogen in steel. The experimental data indicated that in the oxy-acetylene flame only about 0·02 per cent. N_2 was absorbed. In arc welding, a long arc increased the N_2 pick-up from 0·15 to 0·20 per cent.; the pick-up was reduced by suitable coating, and it was suggested that the nitrides were formed by the action of atomic nitrogen as a result of the dissociation of the molecular nitrogen in the arc.

Coatings on weld rods were designed to fulfil several functions:

(*a*) To protect the metal during transference from the rod to the work from contamination with air, whereby the oxygen and nitrogen contents of the deposited metal were increased.

(*b*) As a medium for providing arc-stabilising oxides; for the introduction of deoxidising elements, and of alloying elements into the weld metal.

(*c*) As a means of control of the mechanism of flow of metal and rate of cooling.

The protagonists of the cellulosic-flux-coated rods stated that in many cases heavily fluxed rods (without the cellulosic constituent) utilised a flux of an oxidising character, and that although the nitrogen content of the weld metal was kept low, the oxygen content was relatively high. To this extent, it was suggested, the metal was not so good, although the rods were easy of use and in large demand. Dr. Swinden remarked that the virtues of the heavy-flux-coated rods were not adequately dealt with in the papers.

The "shielded" arc rod consisted of a rod having a cellulosic compound as an essential part of the coating, which, during the welding operation, decomposed so as to provide a protective gas shield (largely CO and H_2) round the metal during welding. Mr. J. F. Lincoln (Lincoln Electric Company, U.S.A.) dealt in detail with that particular type of rod, while Dr. Reeve and Dr. Harris also gave data in support of the claims made. The tests given for that type of rod were very good, and, in regard to impact value, exceeded those normally obtained on the parent metal.

There was reason to believe that hydrogen was soluble to an appreciable extent in liquid steel, and, therefore, the flux and alloys used in conjunction with cellulosic compounds required careful balance if unsoundness was to be avoided. It was usual to find a considerable increase of silicon content of the deposited metal when such rods were used, although it was somewhat difficult to be quite sure that all the silicon normally reported was in the metallic form.

Ageing in mild steel had received a considerable amount of attention for some time; "ageing," resulting in loss of ductility, could occur following critical straining and low-temperature annealing, and also by quenching from a "solution" temperature and allowing to stand at room or elevated temperatures. That subject must have attention in regard to weld metal, and possibly some standardised method of testing to satisfy the engineer would be devised.

It was clear that in many cases of welding the conditions favourable to ageing might occur. Differences of opinion were expressed on the relative importance of oxygen and nitrogen in the matter of ageing, but the indications were that under favourable conditions both would definitely accentuate the tendency to ageing. As a safety measure, therefore, it would appear desirable to keep those constituents as low as possible, consistent with the other desiderata for the particular class of work, although the matter must not be overstressed until more evidence was available showing that under practical welding conditions and service conditions of the welded articles ageing to a seriously detrimental extent did occur—keeping in mind that in many cases welded vessels were used at elevated temperatures.

It was claimed by Mr. Lincoln that the shielded arc rod allowed of faster work and greater simplicity of use, as well as greater versatility in use than other types of rods used in fusion arc welding.

A brief reference was made by Mr. Lincoln to the use of the carbon electrode. He stated that under certain conditions deposited metal nearly as good as the best obtainable with the shielded arc was usual. He also referred to the use of bare wire underneath a powdered covering which, on melting, became a heavy slag. There appeared to be a definite, if limited, field for that, as extremely high rates of deposition were claimed with fairly good quality metal.

The "cored" type of electrode was not so well known in this country as in Germany, and the paper by Dr. F. Leitner (Gebr. Bohler and Co., A.G., Vienna, Austria) gave a great deal of practical information on the development of the cored rod in Germany. It was generally agreed that certain metallic oxides facilitated the ionisation of the gap between the electrode and the work and the stabilisation of the arc. Bare wire or lightly coated rods were "processed" to that end, and the heavily coated rods all had constituents in the coating for the same purpose. The cored rod contained as an internal flux, to the extent of 3 to 4 per cent. of the cross section, suitable material produced as an inherent part of the rod.

It was claimed that such rods possessed all the advantages of bare wire with particular reference to automatic welding, and produced work of very good quality.

E. Helin and S. Svantesson (Elektriska Svetsnings, A.B., Göteborg, Sweden, and Welding Supplies, Ltd., London) gave a *résumé* of the behaviour of the metal when using bare and coated rods, with particular reference to the mechanism of transfer of the metal.

The changes occurring in the composition of the rod during deposition of bare, thinly coated and heavily fluxed rods were dealt with at some length, reference being made particularly to the influence of current conditions. Mechanical tests of all weld metal specimens made from the same rod bare, thinly coated, thick oxidising, and thick neutral coating, showed the best tests in the case of the thickly coated rods. Electrodes varying from 4 mm. to 10 mm. diameter were compared and showed a gradual reduction of strength with increasing electrode size, while the ductility was fairly constant. The authors emphasised the necessity for studying all the factors concerned in order to get the best results.

The butt welding of steels was also dealt with, and attention was drawn to the effect of diffusion from the parent metal into the weld—a very important matter. Impact tests quoted indicated that the best results were obtained from a neutral fluxed electrode, allowing the test piece to cool after each bead and using a low current.

R. T. Rolfe, (W. H. Allen, Sons and Co., Ltd.) provided a lot of valuable data on the effect of normalising and low-temperature annealing on the properties of arc and oxy-acetylene welded plates of mild steel. Incidentally, the data provided an interesting comparison of arc and gas welded joints. A bare wire electrode of "good welding iron" gave poor results, and only one of the covered electrodes was consistently good, whilst the one gas welding rod gave good results.

Normalising at 850 deg. Cent. was advised, the beneficial effect being more pronounced in the case of the gas welded joints.

A further study devoted essentially to the nature and characteristics of fluxes in arc welding was specially welcomed, said Dr. Swinden, as that was a field on which a great deal of experimental work had been done on a basis of commercial production, but little had been written in elucidation of the principles involved. The authors—Mr. T. C. R. Shepherd and Mr. M. R. Moritz (Metropolitan-Vickers Electrical Company, Ltd.)—expressed the opinion that the best coating was two-fold in character: a flux melting to a slag which protected the greater part of the molten pool and a gas shield resulting from the burning of an organic wrap, *e.g.*, cotton, to prevent contamination with oxygen and nitrogen.

Heavy loading of the flux with ferro alloys for alloying purposes was not recommended, and the complete "killing" of the deposited metal was not advocated for certain purposes. The analogy of the lack of castability of overkilled steel was mentioned by Dr. Swinden.

Special Steels.—Complicated as were the problems relating to the welding of mild steel, they were increased many-fold when special steels were to be welded. Dr. W. H. Hatfield (Brown-Firth Research Laboratories), in one of the papers, said in effect that all classes of special steel, including corrosion, acid, and heat-resisting types, could be welded successfully, but a suitable technique was necessary for each. For many purposes it was highly desirable, in his opinion, that the deposited metal should be similar in character to the parent metal. The practice of adding special constituents, *viâ* the flux, was criticised, although certain losses might be compensated for by such means.

The welding of constructional Ni steels presented no difficulty, but after-treatment was highly desirable; nor did the Ni-Cr steels, except for the accentuated danger of cracks during cooling down and the still greater necessity for after-treatment to remove the air-hardening tendencies of the material in the vicinity of the weld.

Flux coatings played a very important part in the successful welding of Cr steels, and special methods were adopted to compensate for the losses of Cr in the weld rod; the C content also played an important part.

The low C, high Cr, stainless steels could be welded successfully by any of the fusion welding methods, but the well-known danger of coarse crystallisation around the weld, particularly in the higher (17–20 per cent.) chrome steels, must be recognised, and could not be removed altogether by subsequent treatment. The welding of austenitic steels was dealt with in detail, attention being directed to the danger points to be watched in welding by the various processes. The phenomenon of weld decay could be avoided definitely by suitable modifications of the composition. The atomic hydrogen method enabled bare wire of suitable analysis to be used in welding those highly alloyed steels, and was particularly desirable in the welding of high-aluminium steels of the nitriding type.

The subject was dealt with also by Mr. M. R. Moritz (Metropolitan-Vickers Electrical Company, Ltd.), from the angle of the electrode maker, and means of providing suitable fluxes and compensating for losses during deposition were dealt with in reference to the electric arc and atomic hydrogen processes.

Comparing the two processes, the latter was favoured as being more universally applicable and reliable. The costs were stated to be similar for sizes up to ⅛in. plate, beyond which the arc process was cheaper. After treatment was definitely advocated. Details of welding technique were given, and reference made to the welding of composite (mild steel stainless) sheet.

The welding of high chromium iron and austenitic Cr.-Ni alloys was dealt with in the light of American experience by E. E. Thum (Cleveland Ohio), who advocated fluxed rods. The use of alloying additions by the flux was deprecated. Details were given of the successful welding of 4 to 6 per cent. Cr, 0·5 per cent. Mo, 0·15 per cent C steel, which is used largely in this country also for certain special chemical plant. A heavily coated rod of the same analysis as the tube was used. After treatment of the welds of the more highly alloyed steels was given detailed consideration.

Messrs. W. Andrews and W. C. Welsh, writing with the large experience gained at Imperial Chemical Industries, Ltd., were definitely more cautious in their statements concerning the successful welding of these highly alloyed steels. They stated, for example, that the chromium-bearing steels used in oil cracking and hydrogenation plant, in common with other alloy steels which depended upon the effect of added alloys for their high-tensile properties, were intrinsically unsuitable for fusion welding. Resistance welding was preferred, although the types of defects that might be found by improper resistance welding were illustrated.

In fusion welding high-tensile alloy steel, it had been found desirable not to use weld metal of identical composition with the parent metal. Austenitic Ni-Cr steels had been used on high-tensile alloy steels with success, using any of the fusion welding processes, and that practice was being intensively developed. The difficulty of differential thermal expansion was

recognised, but it was hoped that the production of very low C alloy steels in the H.F. furnace would be of assistance. The thermal hardening of the zone adjacent to the weld itself presented a further problem. It was being tackled by heat treatment, and attention was directed to the value of vanadium and titanium in that direction.

Dealing with corrosion and heat-resisting steels, while the authors considered that fusion welding was not applicable to straight Cr steels, both fusion and resistance methods could be employed successfully to weld the austenitic Ni-Cr series. Of the fusion processes, oxy-acetylene, atomic hydrogen and metallic arc were most suitable. Although the original difficulty of "weld decay" had largely been removed, there still remained the danger of carburisation, and the loss of the decay preventing alloy additions by volatilisation. The absorption of excess C in a weld was a common source of corrosion. There was also a necessary ratio of C to Ti content in those austenitic Ti-bearing alloys to ensure satisfactory results. Although low C content assisted in the prevention of weld decay it was not sufficient alone, and the so-called "decay-free" alloys were still susceptible to carbide precipitation, rendering them liable to corrosive attack. The solution to that would seem to lie in the combination of a low C content with a correct Ti/C ratio and the addition of a percentage of Mo.

Heat-resisting steels, either the straight high-Cr type or the austenitic W and Si bearing series, were amenable to welding, but the former class had a ready tendency to grain growth at high temperature.

Various methods of non-destructive testing of welds were discussed, including X-rays, magnetic testing, and the passage of ultrasonic waves through the seam.

As distinct from the joining of steels by welding, C. R. Déglon (Metropolitan-Vickers Electrical Company, Ltd.) dealt with "building up," as applied to rails. The basic principle was to deposit a metal of about 0·4 per cent. C, 0·6 per cent. Mn, and 0·7 per cent. Cr, relying mainly on the use of a suitable core wire in a suitably fluxed electrode for arc welding. The effect of preheating indicated about 300 deg. to 400 deg. Cent. as the optimum value. The impact value of rail steel at raised temperatures followed the usual type of curve with a minimum of 500 deg. Cent., although that was approximately similar to the value of the rail in the cold.

Steel making and wire drawing were dealt with by Dr. Swinden (United Steel Company, Ltd.) and Mr. E. A. Atkins (Rylands Brothers, Ltd.). Although the temperatures involved in welding were higher than in steel making, a study of the thermo-chemistry of the latter was very helpful. Dr. Swinden's paper discussed rimming steel, and gave some new data in regard to the influence of certain gases in producing unsoundness. The main point of his paper was to emphasise the importance of the type of steel used in mild steel rods. The wire drawing "coat" of iron oxide and lime was important in assisting the electronic flow with particular reference to bare wire welding, which was still used extensively where static loading only was encountered. Atkins also pointed out that the ordinary chemical analysis did not necessarily tell the whole story as to the quality of steel for weld rods, and he drew attention to the influence of the quality of the parent metal.

The welding of cast iron had its own particular problems, and some of them were dealt with in a paper by Mr. J. G. Pearce (Director, British Cast Iron Research Association), who explained the metallurgy of cast iron as applied to welding. It was considered that the welding of cast iron could now be accomplished satisfactorily. Preheating was highly desirable as a preliminary to welding, and the silicon in the rod should be sufficiently high to allow of silicon loss and still leave sufficient to ensure soft and machinable metal being deposited. The possibilities of the austenitic irons of the Ni-Cr-Cu type and Ni-Cr-Si type required to be fully explained.

Three papers dealt with gas welding. The paper by Dr. A. B. Kinzel (Union Carbide and Carbon Research Laboratories, Inc., U.S.A.) was of first importance. For satisfactory and considerably faster oxy-acetylene welding the author recommended the use of an excess acetylene flame which both cleansed the metal surface by reduction and produced a thin layer of carburised steel which melted at a lower temperature, but which diffused evenly through the infilled metal. The Mn and Si in the filler rod should be such as to result, on oxidation, in a readily fused iron-manganese-silicate type of slag.

It was claimed that, properly operated, stress development in the joint was controlled, although the physical properties of all deposited metal were improved by normalising. It was also claimed that autogenous welding allowed maximum control of atmosphere, type of slag, and heat distribution, and lent itself most readily to the application of metallurgical principles.

A preliminary survey of the changes in composition during gas welding was also reported by Professor Portevin and Monsieur A. Leroy (France). Silicon reduced the carbon loss, but did not appear to preserve manganese, nor did increase of manganese appear to reduce carbon.

After close observation and experiment, Dr. E. Streb and Dr. H. Kemper (Technische Chemische Reichsanstalt, Berlin) arrived at an ideal analysis for acetylene welding rods, and presented a thorough survey of the subject with specially interesting results in connection with the welding of high-tensile structural steels. The phenomena of splashing during deposition, and porosity in the weld, were ascribed respectively to reaction between hydrogen and metallic oxides and slow "metallic" reactions proceeding after deposition. It was proposed that for ordinary mild steel the Si should be 0·2 per cent.; S, 0·04 max.; P, 0·05 max.; Mn, 0·6–1·0; and C, 0·15–0·25 per cent.

Welding tests with alloyed steel rods for use with high-tensile steels showed that superior tensile strength was obtained with Ni-Mo, Ni-Cr, Cr-Mo, and high Mn qualities. As regarded impact value, however, Ni and Mn steels showed to better advantage; but the author noted that the production of high impact values without after treatment of the weld had not yet been solved completely. For the best all-round performance it was suggested that 3½ per cent. Ni and high Mn (1½–2 per cent.) steels were most satisfactory.

Two papers dealt with new methods for the investigation of welding. Mr. J. Sack (Philips Industrial) surveyed the various methods that had been employed to study the transfer of metal through the welding arc. The latest was a radio-cinematograph method employing X-rays. The method had several advantages, among which were the complete penetration of the shielding vapours around the arc and the clear contrast shown between the core and the flux of coated electrodes. By that method it was proved that with some heavily coated rods the drop formation took place within the covering and fell into the crater without short-circuiting; with others and with bare wire the globules adopted the mushroom formation; whilst a third type exhibited a "pinched" or pointed form owing probably to electrodynamic forces.

The coating of covered rods, too, differed in method of transfer. In some cases the sleeve melted and surrounded the drop prior to its deposition, and in others the whole circumference of the sleeve was transferred in drops continuously.

No definite preference was expressed as a result of the investigation. Further developments of the radio-cinematographic method were to be anticipated.

Finally, Dr. P. Chevenard and Professor Portevin (France) dealt with the micro mechanical study of welds. They had devised a special apparatus whereby the mechanical properties at minute intervals of distance through a welded joint could be determined. The micro machine determined tensile, shear, and deflection stresses on specimens of from 1 mm. to 1½ mm. diameter, the stress-strain diagram was registered photographically, and elastic limit, ultimate stress and elongation could be traced.

Many of the characteristics of different types of welds were demonstrated by tests. It was suggested that as the specimen required was so very small, the method might be applied to the examination of actual welded structures *in situ*, the tiny trepanned holes being filled in again by welding.

DISCUSSION.

Professor A. Portevin (France), who said that neither the magnetic nor the acoustic non-destructive tests of welds were completely satisfying, added that the X-ray test involved the use of large and expensive apparatus, and expressed the hope that such methods would be made available in a more portable form. He saw considerable possibilities in the direction of partly destructive tests by the removal from the finished work of a very small sample, which could be submitted to laboratory tests, the hole made by the removal of the sample being filled up with weld metal.

Emphasising the extreme importance of procedure control in welding, he referred to an accident to a large pipe of 2½ m. diameter on a hydro-electric scheme. Apparently it was welded under perfect conditions, the steel was of the right kind, the workers were subjected to periodical tests; yet the pipe had broken in service and nine people had been killed. The fragments indicated that, in spite of the precautions taken, the welding had been done very badly; no records of the regulation of the work during the process existed.

Dr. F. Rapatz (Germany), discussing the comparative merits of covered and bare electrodes, said the chief enemies of good welding were oxygen and nitrogen—oxygen because it rendered the steel bad from the chemical point of view, and the nitrogen because it rendered the steel bad mechanically. Smithing should remove the oxygen; but the effects of the presence of nitrogen in the wrong form were not removed in that way. The use of bare electrodes, introducing nitrogen into the welds, rendered the steel hard. He suggested that, just as in certain non-corrosive steels there was danger of the formation of a compound wherein the carbon was not held in solution, but was free, a similar effect resulted from the introduction of nitrogen into welds by the use of bare electrodes. A method of overcoming it was to include in the electrode metal an alloy of zircon together with manganese, the effect of which was to render the nitrogen safe, for it was held in a compound so that it had no deleterious effect. Alloy steels were not easily weldable with bare electrodes because the layers of non-metallic material that were apt to be deposited in the weld caused a flickering of the arc.

Several hundred tons of cored flux electrodes were sold in Germany every year, for use particularly in very high classes of welding in structural and other work. Their chief advantages were firstly price; secondly, that no excessive slag was formed; thirdly, there was less evolution of heat and consequently less tendency, or no tendency, to cracking when fillet welds were deposited; and there was very little tendency to undercutting. Moreover, the elements zircon and manganese which might be added were uniformly distributed, and the completed work had a good appearance.

The dictum that the parent metal and weld metal should have the same properties he regarded as too rigid. We should merely ask that the weld metal should possess the requisite qualities of strength, elongation, fatigue resistance, and so on, without imposing upon it the further requirement of identity with the parent metal.

This concluded the discussion on Group III.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

GRID TRADING.

SIR,—I have read your editorial in the issue of THE ENGINEER for May 3rd, 1935, and was surprised to note that you accept the contentions of Mr. George Balfour and Sir Francis Fladgate, that their companies are suffering from an injustice due to the operation of the Central Electricity Board under the 1926 Electricity (Supply) Act.

As you are aware, Section 13 of the Act provides that under no circumstances can an undertaking be called upon to pay more for its supplies than the amount for which it could show it could have generated its own supplies, had the 1926 Act not been passed. In the case of non-agreement as to what the cost would have been, the Electricity Commission acts as arbitrator, and its decision is final and binding on both parties. Thus a complete safeguard is given that no undertaker need be in a worse position under the Act. In view of this it seems evident that the particular companies concerned either have not managed their own affairs efficiently or they want an advantage for themselves from the operation of the Act.

It has to be remembered that the Central Board has no separate funds of its own. It merely controls a common fund, and therefore if any undertaking obtains a financial advantage this advantage is not gained at the expense of the Board, but at the expense of the other undertakings in the particular area. Thus, the Board is in the position of a trustee, and must operate its undertaking within the provisions of its Act to give equity, as nearly as is practical, to all the undertakings covered by its respective schemes and areas.

The fundamental object of the 1926 Act was to organise the generation of electricity for public supply, so that the cost of generation, and/or bulk supplies, to all statutory undertakings was the lowest possible. It was not intended to enable any undertaking to reduce its costs at the expense of other undertakings. So far as "selected station" undertakings are concerned, the "Grid" is merely an extension of the power station bus-bars which enables the proportion of standby plant to be reduced and the most efficient plant to generate the majority of the units, irrespective of which undertaking consumes the units. It will take some years for real benefits to accrue to the industry. In the interim period, so long as the costs of supply to a selected station undertaking are not greater than they would have been under independent operation (and this is ensured by Section 13), reasonable equity is given.

It would appear that the companies referred to in your editorial consider that, when the Board provides load for what would have been standby plant under independent operation, the Board should pay capital charges on such standby plant proportional to the use made of it. To do so would put across one of the fundamental purposes of the Act, which was to cut down the proportion of standby plant. The Board has provided the "Grid," which enables the existing spare plant to be used, and future standby plant to be reduced; surely, the savings effected by the "Grid" should go towards the cost of the "Grid."

The existing standby plant was provided by the companies concerned for their own purposes, and the whole of the capital charges concerned have been paid by the companies in the past with the plant lying idle most of its time. The "Grid" schemes make it possible to use such plant, and so long as the Board pays all the extra cost due to running the plant, I find it difficult to see that any injustice is being done to the owners. As a matter of fact, under Section 7, the running costs include a proportion of

wages and salaries, and as the thermal efficiency of a station tends to rise with load factor, then by applying Section 7, with capital charges excluded, the owners must be somewhat better off than under independent operation or under Section 13. The fact that the Act precludes them from making an extra profit at the expense of other undertakers would be taken by an unbiassed person as an example of equity and not injustice. If the companies' contention were conceded, then injustice would accrue to other undertakers. So long as the use of their plant costs them nothing in any shape or form, and in fact actually reduces their costs somewhat, the grudging of the use of the plant for the general good might be characterised as a "dog-in-the-manger" policy.

As regards the costs of supply of power from the London Power Company to its constituent companies, it appears to me that the facts given out by Sir Francis Fladgate must be incomplete and misleading. The normal person would draw the inference that the rise in cost which took place last year, which coincided with the first year of trading of the South-East England scheme, was due to the operation of the scheme, which, to informed opinion, does not seem possible in view of Section 13 of the 1926 Act. All students of power supply economics are aware that the capital charges on generation, expressed in cost per unit, always show a succession of cycles of sudden increase and progressive decrease. This arises from the fact that as soon as an extension of generation plant is completed the full capital charges normally accrue immediately, whilst a delay takes place in loading up the new plant, and consequently the revenue lags behind. As the plant is loaded up, due to growth of load, the units output increases while the sum total of capital charge remains constant, and the capital charge per unit decreases, until another extension is necessary, when the cycle is repeated.

I understand that the London Power Company has no authority to provide a reserve fund for the equalisation of charges to its constituent companies year by year, and therefore is bound to allocate the full cost for any year to its constituents. I also understand that capital charges on the new Battersea power station have been suspended for a time, but last year, under its own Act, they became operative for the first time; so that, last year, the costs of the London Power Company experienced the sudden increase referred to in the previous paragraph. If Sir Francis Fladgate wishes to be free from any suspicion of influencing opinion by giving incomplete facts which invite misleading inferences, it appears to me that he should supply the whole of the facts with the same publicity that he gave his original statement. The facts referred to are :—

(1) Total average costs of supply per unit for 1933.

(2) Total average costs of supply per unit for 1934 :

(*a*) with the added capital charges for Battersea;

(*b*) without the added capital charges for Battersea.

A true comparison would then be available. No informed engineer will credit that the rise in cost last year was in any way due to the operation of the Board.

It is to be expected that the application of Section 7 or Section 13 of the 1926 Act will always be attended with difficulties, for while the principles upon which the sections are based are relatively simple and the intentions equitable, when applying simple principles to complex matters the application is bound to become complex; and when interests conflict, the application becomes more difficult. It appears probable that, theoretically, the difficulties will increase as time goes on, but as against that it is probable that practice in the application of the sections will establish precedents, cases, and principles, which will tend to smooth over some of the present difficulties. It may well be, however, that the difficulties now so prominent in the cases referred to in your editorial will become so enhanced as time goes on as to become unworkable. This will surely be the case if due regard is not given to the main objects of the 1926 Act, and a willing spirit of compromise is not exhibited by the majority of electricity authorities; legislative action will then become necessary.

What form these changes would take no one can foresee with certainty, but it might be well to remember that when the 1919 Electricity (Supply) Act was a Bill the then proposed compulsory powers of the Commissioners (failing agreement) to form Joint Electricity Authorities, with the main object of pooling area generating resources aroused most strenuous opposition, and if my memory serves me rightly, Mr. George Balfour took a prominent part in such opposition, with the result that the compulsory powers were eliminated, and the prospects of pooling generating stations on an area basis became almost non-existent. It appears to me that the direct result of that opposition is the 1926 Act, which is far more sweeping in its curtailment of individual electricity authorities' powers than was proposed in the 1919 Bill. If changes do become necessary, in considering their possible form it may be well to point out that the logical development of the principles underlying the 1926 Act is the pooling of all the public generating stations in the country under the ownership of a central authority, and the institution of tariffs based on quantity and load factor to all distribution authorities, either as constituted at present or in some new form, with a more logical apportionment of area. I can conceive the opposition and statements referred to in your editorial hastening on the time when such sweeping changes will be brought about.

J. N. WAITE,
General Manager and Engineer.
Corporation of Kingston-upon-Hull,
Electricity Department,
May 29th.

[The inherent weakness, not to say failure, of Section 7 of the 1926 Act is apparently recognised by Mr. Waite, since he lays great stress on the security afforded to authorised undertakers by the alternative application of Section 13. Unfortunately, anyone possessing an intimate knowledge of electricity supply costs will appreciate the very real difficulty of applying Section 13 in actual practice—a difficulty, moreover, which will inevitably increase with the passage of time, as Mr. Waite admits.

Any estimates of costs based on the assumption of conditions which would have obtained had there been no 1926 Act must—from their very nature—be unreliable, since there are necessarily many variables, including factors of a more or less indeterminate nature. Anyone, as Henry Ford observes, can say what a cost *is*; no one can say what a cost might be.

It appears to us that the policy which Mr. Waite applauds is, in effect, nothing more or less than the old one of expropriation, and, therefore, it necessarily makes an invidious and inequitable distinction between the users of the output of a supply undertaking.

It is well known that the London Power Company has provided the necessary plant for, and takes all the risks incidental to, the generation and supply of electricity on a large scale, and, furthermore, its financial commitments are backed by the security of the nine constituent companies which comprise its only consumers (with the exception of the St. Marylebone Corporation and the Central Electricity Board). Surely, therefore, it is but equitable that the constituent companies should receive in full measure the advantages accruing from the efficient operation of the power company's generating stations, and, conversely, far from equitable that the C.E.B. should draw large peak load supplies from those stations, at a price which hardly represents the bare "differential" cost, for the purpose of passing them on to other undertakers at costs below those apportioned to the several constituent companies.

An advantage may accrue in time to the power company from its association with the C.E.B. in the matter of the provision of standby plant available in other generating stations connected to the Central Board's transmission system, but experience to date has not shown that this time has yet arrived.

On the question of the London Power Company's total average costs of supply for the years 1933 and 1934, Mr. Waite may be referred to Sir Francis Fladgate's speech to the shareholders in February last, in which he stated that there had been a substantial *reduction* in the figure for 1934, which, including the added capital charges on Battersea, amounted to some 9 per cent. as compared with 1933.

Admittedly, the incidence of the capital charges in respect of the Battersea generating station produced a very perceptible increase in the fixed costs for the year 1934, but, this notwithstanding, it is true to say that the increase in cost to the constituent companies for the year 1934 arose from the fact that, whereas in 1932 and 1933 the C.E.B. paid a reasonably economic price for the energy supplied to it, in 1934 it ceased to do so, and, in fact, refused to pay anything over and above the bare "differential" cost of production.

With regard to Mr. Waite's references to such matters as "extra profit" and "dog-in-the-manger" policy, we are convinced that the power company has never attempted to make any extra profit, or, indeed, any profit at all, out of the C.E.B. It has, however, we are informed, attempted to maintain an equitable balance between the costs of the several supplies furnished from its system.—ED. THE E.]

SOCIAL CREDIT.

SIR,—The defects referred to in Mr. Hugh P. Vowles' letter lie not so much in modern industrialism as in the existing financial system. The answers to his three questions are :—

(1) Yes; the shortage of purchasing power is evidenced by a general abstinence from the satisfaction of individual needs, co-existent with the destruction and restriction of real wealth, the very abundance of which is an embarrassment to the money power.

(2) The reason for that shortage is the failure of the money power to finance the consumer; so long as the prime function of finance is conceived to be the piling up of debt rather than the cancellation of costs through consumption, so long will the shortage of purchasing power remain.

(3) The National Dividend Discount proposals are Major Douglas' solution, and it is a remedy which is gaining support amongst thoughtful and unprejudiced persons.

If Mr. Vowles has more than a doctrinaire interest in the question of monetary reform, will he not favour your readers with a statement of the concrete proposals which he would advocate ?

NEW BRITON.

Lymington, June 2nd.

SHORTAGE OF SKILLED MEN.

SIR,—The question of the shortage of skilled men, referred to in THE ENGINEER, is of importance to every trade in which skilled men are employed, but is of supreme importance to the engineering and allied trades, and should be faced without delay.

That a shortage of skilled men, particularly toolmakers, does exist is beyond dispute. I have heard it stated repeatedly by employers that really skilled toolmakers and tool setters are not available, *i.e.*, they are all employed, and that production is consequently limited. Such a condition, in some circumstances, may prove very serious, and measures should be taken without delay to effect a remedy.

It is a fallacy to imagine, as apparently one of your correspondents does, that unskilled men and women can be quickly trained to do a skilled man's job. Anyone who thinks this was done during the war is greatly mistaken, as those of us who shared the responsibility of getting unskilled people trained, during that great emergency, are fully aware. The fact was, and is, that it is always necessary to have a skilled man to train the unskilled to do even a very simple operation, after which other skilled men are required to "make" and to "set" the tools which make it possible for the unskilled to continue carrying on with the job they have been taught to do.

The skilled men are, in every sense, "key" men, in any industry, but in the engineering industry they are something more : they are a real asset to the country, and should be recognised as such.

It was men of the Henry Maudslay type that made engineering possible in those early days, and we are just as dependent to-day, though in a different way, on the skill and craftsmanship of the trained men for the rapid and accurate production of the present time.

The Chancellor of the Exchequer, looking forward, says he fears a shortage of men of the right breed. That may be serious enough, but it is positively dangerous to any country to be short of skilled engineers, and skilled toolmakers in particular.

Surely it is high time this matter received some attention and steps taken to ensure a sufficient number of men being trained to fill these "key" positions. At present it is anybody's job, and therefore, as usual, it is nobody's.

JOHN HOLLOWAY.

Burnham, Bucks.,
June 3rd.

[We may remind Mr. Holloway that on the second reading of the Finance Bill, the Chancellor of the Exchequer said that the question of skilled labour would receive the attention of the Government in the near future.—ED. THE E.]

Multiple Arc Welding Equipments.

DEVELOPMENTS in the art of A.C. welding have led the Oerlikon Company to design an A.C. multiple welding equipment for operating on a three-phase supply. It is claimed by the company that work such as that of welding iron structural parts can be carried out with A.C. quite as well as with D.C., whilst with the aid of the special electrodes now available stainless steel, bronze, &c., can also be satisfactorily welded with A.C. It is admitted, however, that D.C. is rather better suited for welding thin sheets, and it is indispensable when using bare electrodes for that purpose.

When equipping a large welding shop with D.C. plant the task of choosing between single and multiple welding equipment is not always easy. Multiple welding equipments present the advantage of costing relatively less to

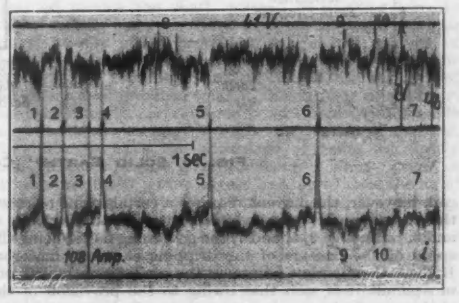


FIG. 1—OSCILLOGRAM OF WELDING OPERATION

install and of being simple, while the single welding equipments have a higher efficiency. The somewhat lower efficiency of multiple welding plant is due to the losses in the current regulator. In the Oerlikon D.C. sets there is embodied a choking coil and an ohmic resistance adjustable in fine steps by means of a hand wheel. As it produces a pressure drop proportional to the current, the resistance of the current regulator fixes the value of the current. The terminal pressure at the bus-bars must obviously cover the arc pressure and the drop in the regulator. Owing to unsteadiness in holding the electrodes and to the melting process, the arc pressure is subject to variations, and if the terminal pressure be too low the stabilising effect of the regulator is insufficient, the current is unstable, and the arc has a tendency to be extinguished. Hence the welds are no longer perfect. The higher the terminal pressure the more pressure the regulator has to consume as compared with that across the arc and the less does the current respond to the fluctuations, but the greater are the losses in the regulator.

A desire to secure a high efficiency has hindered the attainment of a high degree of stability, but in order to obtain the most favourable conditions renewed attention has recently been paid by the Oerlikon Company to the current regulator. The purpose of the choking coil is to compensate the rapid fluctuations of the arc pressure so that the current may only respond to the slow fluctuations of that pressure. Oscillograms of the arc pressure show that the rapid fluctuations have a much greater amplitude than the slow fluctuations. When the current regulator is

equipped with a suitably proportioned choking coil the ohmic pressure drop can be reduced considerably without affecting the welding capacity of the equipment. Whereas the old Oerlikon equipments had a terminal pressure of 60 to 65 volts, that of the latest equipments is from 40 to 45 volts. Many electrodes operate at an average pressure of 18 to 20 volts, and the favourable effect of the choking coil is only noticeable when welding is done with a small current or with a terminal pressure below 40 volts. But to ensure satisfactory operation with all kinds of electrodes

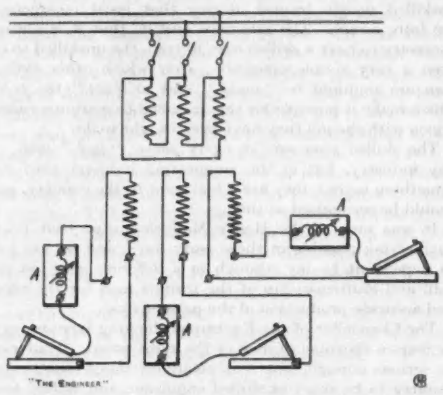


FIG. 2—THREE-PHASE WELDING SET

the terminal pressure of the equipment should not be below 40 volts.

With a view to showing the favourable effect of the choking coil the oscillogram, Fig. 1, was taken during a welding operation with a covered No. 8 A.W.P. electrode. The average current was 110 ampères and the average arc pressure 27 volts. The generator terminal or bus-bar pressure U was 41 volts. At the points 1 to 7 the arc path was short circuited momentarily by dropping electrode metal, and as the arc pressure at these points was zero, the whole of the generator pressure was then applied to the current regulator. The welding current thus increased to the short circuit value $\frac{U}{R}$, R being the resistance of the current regulator. As the circuit includes the choking coil, however, the current requires a certain time to reach the short-circuit value, which occurs at points 1, 2, 4, and 6, but not at 3, 5, and 7, the governing factor being the speed of the passage of the dripping electrode material. If these short-circuit points on the oscillogram be left out of account it is seen that owing to the provision of the choking coil the current variations are less pronounced than those of the arc pressure. At the critical points 8, 9, and 10 in the upper part of the diagram the arc pressure reaches the value of the generator pressure and in the absence of the choking coil the current would have to drop to zero and the arc would be extinguished. In the following table a comparison is made of the efficiency of the old and new equipments for *n* operators.

Equipment for n *Operators with a Rated Current of* 220 *Ampères per weld.*

Pressure at the bus-bars	60 volts	42 volts
Welding current	$n \times 220$ amp.	$n \times 220$ amp.
Rated output of the equipment	$n \times 13{\cdot}2$ kW	$n \times 9{\cdot}2$ kW
Arc pressure	25 volts	25 volts
Power consumption—		
Arc	$n \times 5{\cdot}5$ kW	$n \times 5{\cdot}5$ kW
Current regulator	$n \times 7{\cdot}7$ kW	$n \times 3{\cdot}7$ kW
Efficiency	0·42	0·60
Equipment	Old	New

The efficiency indicated represents the ratio between the power consumed in the arc and that supplied by the bus-bars or the power consumed in the arc plus the losses in the current regulator, the overall efficiency of the equipment being obtained by multiplying efficiency by that of the motor generator set. The new equipments have an efficiency 45 per cent. higher than that of the old equipments. Low installation costs and high efficiency are the outstanding advantages claimed for the Oerlikon A.C. multiple welding equipments. The usual arrangement for a three-phase supply is shown in Fig. 2. At full load this scheme gives symmetrical loading on the system. Each of the three secondary phases of an inexpensive standard three-phase transformer feeds a weld through a regulating resistance A, the primary side of the transformer being connected to the three-phase system through a switch. Each regulator actually contains two regulating reactances on a common core. One can be regulated by a twelve-step switch, while the other has a fixed current setting and can be connected in parallel with the adjustable reactance by means of a switch. In this way two twelve-step ranges are obtained, the windings being arranged so that the transfer takes place from one range to the other without overlapping, and the regulation of the welding current takes place in fine steps. The equipment is designed for a rated load of three times 220 ampères for a "relative working period" of 70 per cent. Readings taken on a recording ammeter in the welding shop of the Oerlikon Company have shown that this "relative working period" corresponds to very intensive welding work, such as when operating on large parts. The transformer and regulators can be mounted on rollers to enable them to be moved from place to place with ease. While at full rated load the efficiency of the A.C. equipment is about 82 per cent., that of a corresponding D.C. equipment is about 46 per cent., including the losses in the motor generator set.

A Portable Earth Tester.

THE efficient earthing of metal casings surrounding electrical apparatus in factories, workshops, sub-stations, &c., which come under the supervision of the Home Office, has been called for by the electricity regulations for a number of years, and the importance of earthing in other installations is also now recognised. Electrical engineers are, of course, familiar with the objects of earthing. Others, however, who use electrical apparatus, may not always appreciate its importance. The consumer's apparatus shown in the left-hand diagram below is protected by fuses or over-current devices, whilst the metal casings are bonded together and connected to an earth electrode. This is known as the solid earth system of protection, and one of its objects is to avoid a high stray voltage between a metal casing and earth. Hence, the resistance X, which is not an inserted resistance, but a resistance which must necessarily exist, must be kept low.

Another object of earthing is to conduct away small and harmless fault currents that may arise and to interrupt the supply to the faulty point in the event of the currents exceeding a specified limit set by the fusing current of the fuses or the setting of the over-current devices. Earthing is efficient only when the impedance of the complete earth circuit X–Y is low enough to permit the flow of sufficient current to blow the fuses or operate the over-current devices. This implies that the impedance of the earth circuit must not exceed certain values which depend on the circuit rating. If this condition is complied with it is safe to assume that the resistance X, which forms part of the complete circuit, is also sufficiently low to avoid high stray voltages, and consequently, in testing for the efficacy of earthing, it is sufficient to measure, the impedance of the complete earth circuit. Incidentally it is not always possible to protect a circuit against earth faults by means of fuses, for in circuits of high current ratings it may be impossible to secure a sufficiently low earth resistance, and some alternative earth leakage protective device, such as a switch fitted with core balance protection or an earth trip switch must then be used.

The impedance of the earth circuit must not only be low at the outset, but must remain low at all times, and it is essential that its impedance should be measured periodically. A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, have therefore evolved a portable earth tester not only for the purpose of checking the continuity and resistance of the local earth wiring on a consumer's premises, but also for measuring the impedance of the complete earth-fault circuit from the remotest point of the system to the supply neutral earth electrode. With its aid anyone can readily ascertain whether the earthing is sound.

The tester contains an indicating meter connected in series with a resistance and calibrated in ohms on the basis of a standard voltage. By plugging it into the nearest socket or lamp holder, and by touching the metal casing of the apparatus under test with a wander contact, the meter is connected in the earth circuit, and a low potential is applied to the casing, so that a current traverses the earth fault circuit and the impedance of the circuit is indicated in ohms on the meter scale. In addition to the indicating meter, the instrument case contains a small step-down transformer, a polarity-indicating neon lamp, calibrating resistances, fuses, testing switches, testing leads, a dry battery, and a flexible cable, with a special adapter, capable of being plugged into a 5 ampère socket, a 15 ampère socket, or a lamp holder.

The standard tester is supplied for pressures from 200 to 260 volts, whilst one model, designated "U" (Urban), has a range of 0 to 100 ohms, whilst another, "R" (Rural), has a range from 0 to 500 ohms. Instruments for voltages other than those mentioned, can also be supplied. Before it is put into service each instrument is adjusted to suit the supply voltage, but even if this varies satisfactory readings can still be obtained by using the calibrating resistance, which also enables satisfactory readings to be obtained when the potential of the neutral wire is above that of earth.

The simplified diagram below shows the application of the instrument to the measurement of the impedance of a complete earth-fault circuit similar to that shown in the left-hand diagram. To make the test the instrument is plugged into the nearest A.C. supply point and the wander contact is clipped to the metal casing of the appliance under test. If the polarity of the wiring is correct, a current of a few milliampères flows to earth from the live wire through the neon lamp and the switch S, which is normally in the position shown. If the neon lamp does not light, the polarity of the wiring is incorrect and the supply to the tester must be reversed by reversing one of the plugs. The switch S is then moved to the test position, and this connects the 30-volt winding of the transformer into the circuit, thus causing a current to flow through the meter, the wander lead, the earth-continuity conductor, the consumer's earth electrode, the sub-station earth-electrode, the neutral conductor, and back again to the neutral connection of the 30-volt winding, when the impedance of the circuit can be read.

The fact that the circuit traversed by the testing current differs slightly from the earth-fault circuit in that the neutral conductor is substituted for the live conductor, is of little importance, for in practice the impedances of these two conductors are frequently equal, and even if they are not, they form but a small proportion of the total impedance. Besides testing the impedance of the complete circuit, it is also possible to measure the resistance of the earth continuity between any two points, such, for example, as between the metal casing of the apparatus under test and the earth electrode, either with the A.C., as before, or with D.C., obtained from the dry battery contained in the tester. The test enables a defect in the earth wiring to be located if it has been shown to exist by the test on the complete circuit, or to check the resistance of the earth wiring after an installation has been completed, but before it is connected up to the supply.

The instrument may be used generally for measuring resistance and to indicate whether the polarity of the wiring to a socket is in accordance with the I.E.E. regulations.

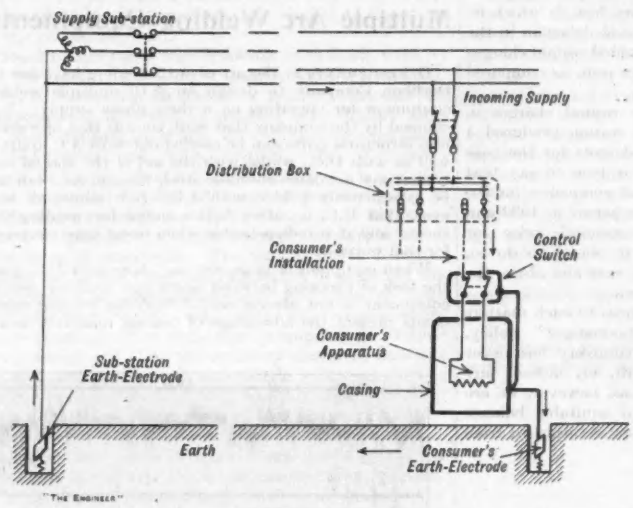


FIG. 1—"SOLID EARTH" CONNECTIONS

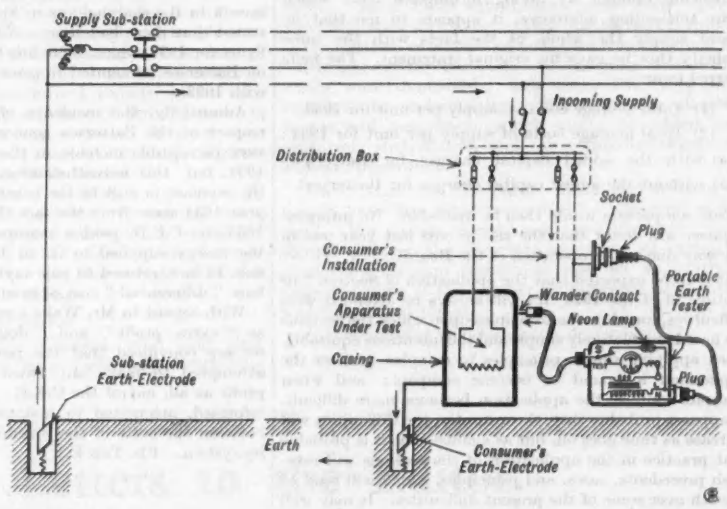


FIG. 2—EARTH TESTER CONNECTIONS

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

THE GENERAL ELECTRIC COMPANY, Ltd., has received an order to equip Croydon Aerodrome with eight special floodlights, which are to be placed at intervals around the edge of the landing area. They are rated at 6 kW each, and are similar in construction to the G.E.C. 9-kW standard model, with the exception that they have two 1000-watt Osram lamps per trough instead of three.

LAUNCHES AND TRIAL TRIPS.

FLASH, coal barge; built by Henry Scarr, Ltd. (controlled by Richard Dunston, Ltd.), to the order of Yorkshire owners; dimensions, 62ft. by 14ft. 8in. by 5ft.; to carry 55 tons of coal. Oil engine, Widdop vertical twin-cylinder heavy oil engine; trial trip, recently.

GREBE COCK, single-screw sea-going tugboat; built by Cammell Laird and Co., Ltd., to the order of the Liverpool Screw Towing and Lighterage Company; dimensions, 95ft. by 25ft. by 12ft. 6in. Engines, triple-expansion, 16in. by 26in. and 42in. by 27in. stroke, pressure 165 lb. per square inch; constructed by the builders; launch, June 1st.

Running Defects and Failures of Centrifugal Pumps.

IT is difficult to foresee all the defects that may happen in running centrifugal pumps; defects due to a faulty estimation of the pump's duty or to an error of construction of the pump, or else to defective installation.

In *Metaux et Machines* for March, 1935, Mons. T. Guerin, A.M., reviews certain cases, showing both their symptoms and their remedies. In Fig. 1 we illustrate the performance of a typical centrifugal pump.

First Case.—The pump is well flooded. On starting with the valve shut, normal gauge pressure is obtained. On opening the valve the pressure drops and no output is obtained.

(*a*) The pump rotation is reversed (or in the case of a multi-cellular pump, a turbine unit or diffuser is reversed). The fault is characteristic as at the least valve opening the pressure drop is instantaneous.

(*b*) The foot valve is jammed and does not open. A vacuum gauge placed on the inlet then indicates a vacuum much larger than that which corresponds to the suction height of the pump. The water flows a little at first, then after several seconds it ceases and the gauge returns to normal. Dismantle the valve at the foot and make sure that it has sufficient rise.

Second Case.—The pump, after flooding, is started up and the valve is opened. The pump delivers water for a few seconds, then ceases to deliver and the pressure gauge drops to 0. Place a vacuum gauge on the inlet. At the moment when the pump ceases to deliver the vacuum-gauge gives less vacuum than that which corresponds to the suction lift. Flooding is defective and a pocket of air has been created which cuts out the suction of the pump.

Third Case.—At the moment of starting and before opening the valve, the gauge pressure is lower than normal pressure. The pump is not completely filled with water. Recommence the flooding, carefully removing all air.

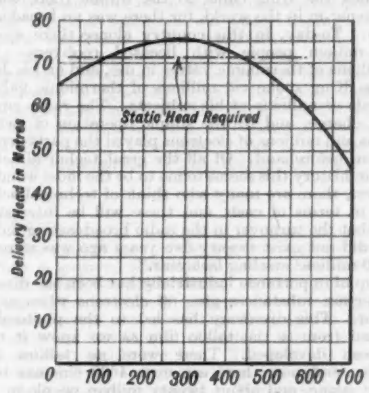


FIG. 1

Make sure that the priming cock is filled and that its level does not fall when the flooding is complete. Sometimes it happens that the foot valve is not tight and that the pump partly empties itself between flooding and starting up.

Fourth Case.—The pump starts up normally. On opening the valve the pressure of the water rises, but without reaching its proper figure. The delivery of the pump is insufficient. Several possibilities should be examined:

(*a*) The inlet piping is of insufficient size, or the foot valve does not rise a sufficient amount. The vacuum gauge indicates this by reading too high.

(*b*) The inlet pipe is blocked by a foreign body left there during the installation of the pump. The vacuum gauge gives the same indications as above. The pipe should be dismantled for preference at the elbow, if there is one, to find the obstruction. The case of a pump of 180 c.m. an hour which only gave 80 c.m. is cited. The vacuum gauge showed 8 m. height of suction instead of 3 m. The inlet pipe was of cord-protected construction. Dismantled, it was discovered that in pouring lead into one of the joints owing to bad packing with hemp, about 10 kilos. of lead had entered the pipe forming a lengthened plate which, the moment the pump delivered, lifted itself and formed a valve obstructing the passage.

(*c*) The outlet pipe is too small in section. The vacuum gauge indicates a normal vacuum. The pressure gauge reads too high. The pump does not give in this case a sufficient height to overcome the loss of pressure corresponding to normal delivery. The only remedy is to change the piping.

Fifth Case.—The pump starts up normally the first time and gives its normal delivery. If it is stopped and is restarted against a full water column, it refuses to deliver. The pressure gauge indicates, with a closed valve, a pressure only slightly less than normal which does not increase when the valve is opened. This effect is only produced with certain types of pump of which the pressure curve rises an appreciable amount when the delivery is opened and returns to normal immediately. If the height of installation is greater than the pressure reading which is given by the pump with a closed valve, it is impossible for such a pump to start with a full column. It is then necessary either to empty a part of the pressure column or to place in front of the valve a T joint having on its side branch a discharge valve returning the water to the inlet main. In this case, when the motor is at speed, this discharge valve is opened, pressure rises in the gauge, the pressure valve is opened and the pressure column is started up. The discharge valve should be immediately shut. Naturally, if the motor is a continuous-current one, it is sufficient to increase the speed slightly by the field rheostat at starting and to bring the speed to its normal value once the column has started.

Sixth Case.—The pump starts normally, but on opening the suction valve the energy absorbed is more than the capacity of the motor. The reason is that the pump gives too high a pressure. The pressure builds up in a manner which overloads the motor. The remedy is gradually to reduce the opening of the suction valve to bring back the energy absorbed to a normal amount.

Seventh Case.—This is found in feed pumps for boilers, in humidification pumps and in pumps which feed hydraulic sugar centrifuges. The pump being in normal running approaching full load, when certain auxiliary machines are cut out, there is produced in the pump a knocking more or less rapid showing regular oscillations on the pressure gauge and the ammeter, like those

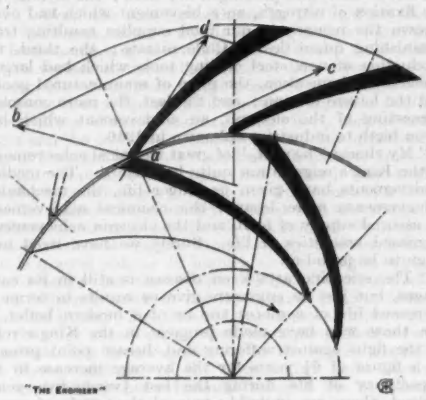


FIG. 2—NORMAL RUNNING CONDITION

which are exhibited by a piston pump. This effect is produced with certain makes of pump which have an ascending curve like that which was indicated in the fifth case, when there is an air pocket or a part of the piping which forms an air pocket, even of small size, in the inlet side. If the delivery is reduced by a certain quantity in the part contained between the height of the curve and the nil delivery, the pump will reduce pressure. At that moment the air pocket will bring about a reversal of pressure on to the pump. This will then react and the phenomenon of knocking will be set up. The remedy is to find the point of imprisoned air in the delivery and there to place an evacuation cock. The air being removed, the phenomenon will disappear. Also, if the pump produces sufficient pressures—12 kilos. to 15 kilos. per square centimetre—and the cushion of air is of small volume, this effect will only be produced for a short time, after the first start, because the air under pressure soon succeeds in dissolving itself in the water and brings the knocking to an end.

Eighth Case.—In certain pumps in which a variable delivery is expected, it may happen that when the delivery

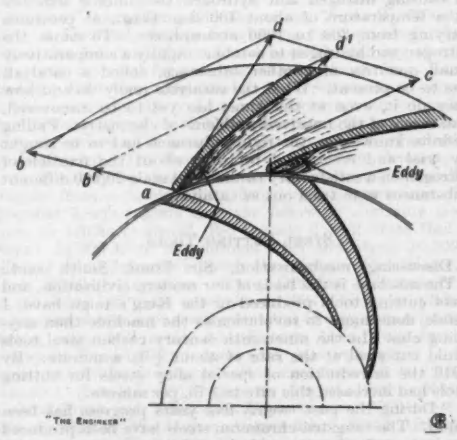


FIG. 3—RUNNING CONDITIONS WITH REDUCED OUTPUT

is reduced to a certain value by the suction cock, there is heard in the pump a fairly strong vibratory sound, somewhat like a circular saw. The reason here is that the pump is working at a pressure too weak for the design of its sections. It therefore produces either at the delivery of the turbine or in the casing or in the diffusers, if the pump has them, a vibration which produces the noise mentioned, and which can cause sufficient damage to be serious if it is not attended to. We shall study this phenomenon further on. Incidentally, if the pump has an excess of pressure, and if the motor horse-power is sufficiently great, it will produce, after a certain opening of the inlet valve, vibrations very nearly identical with those just discussed, but produced by the reverse cause. The delivery of the pump is too great for its characteristics and cavitation occurs.

The sounds produced are perfectly characteristic. At the moment of starting a pump of a certain size, it is noticed that as the valve begins to open, the vibration is about to occur, then, the moment the pump enters into the normal limits of delivery as permitted by the design, this ceases. On continuing to open the valve, provided that the pressure head of the pump is sufficiently great, there arrives a moment when a second vibration is produced. These are what are called in pump work the "lower turbulent zone" and the "upper turbulent zone." It is important to avoid, whenever possible, allowing a pump to work in one of these zones, because serious injuries can be done to the parts of the pump, as will be seen further on. It is evident that with feed pumps and for all those which must work under large variations of delivery, it is not possible always to avoid having the pump working in the lower zone.

Ninth Case.—The pump in normal working produces a light grating, perceptible especially after placing the hand on the body of the pump and the ear on the hand. This is either due to a slight entry of air into the inlet, or an entry of air at the packing gland on the inlet side, if there is one. In the first case it is necessary to inspect all the joints and the tightness of the piping. The entry of air may be sufficiently small not to upset the running of the pump. One can also notice this fault if the delivery is open. An appreciable discharge of bubbles will be seen. In the other case, if this entry is sufficient it can break the continuity of flooding of the pump after a certain time.

TROUBLES OF PUMPS.

Nearly all makers supply a hydraulic joint for the packing glands of centrifugal pumps on the inlet side fed by a water take-off either at the exit of the turbine or from the second or third stage in multi-stage pumps. A return ring called the lantern is placed behind the packing. This hydraulic joint supplies a small quantity of water under pressure to the gland to prevent the entry of air. In working, it is therefore necessary not to tighten excessively these stuffing-boxes, but to leave them in such a condition that a few drops of water have room to escape, which is the best seal to prevent air from entering. At each dismantling one should make sure that the pipe bringing the water to the stuffing-box is not blocked. If in running, the stuffing-box, even when only slightly tightened, does not allow the escape of water, that will indicate that this take-off to the hydraulic

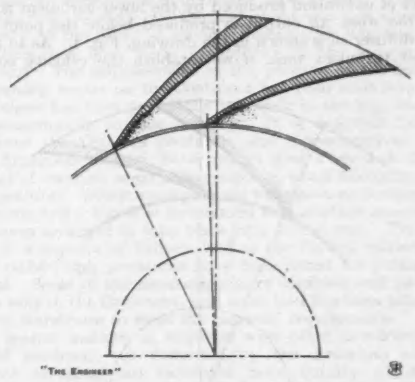


FIG. 4—EROSION OF DIFFUSER DUE TO REDUCED OUTPUT

joint is blocked and should be cleaned out. In many well-designed pumps the shaft, instead of working directly in the stuffing-boxes, is fitted with white metal, steel, or bronze sleeves which protect it against the rubbing of the cord. It is always advisable not to tighten the stuffing-boxes too much, in which case the rubbing of the packing will produce wear on the shaft or on the bearings, and after a certain time it will become impossible to prevent the escape of water at the stuffing-boxes. These sleeves have the advantage of being less costly than the shaft in case of replacements. Many pumps or turbines are fitted with a thrust bearing to take the axial thrust. During dismantling, when replacing this bearing, it should be ascertained that it really prevents the rotor of the pump from rubbing. For that purpose, before putting in place the ball bearing, the shaft of the pump should be pushed home on the inlet side and a measurement of the shaft taken. After fixing the bearing one should ascertain, by reference to this measurement, that the shaft is not touching the casing.

When a pump is dismantled after cleaning the parts, it is necessary to ensure that the wear produced on the guide plates is really concentric and regular. If it is excentric, the shaft should be verified to ensure that it is not out of alignment. Too big a play in the bearings or bad dynamic balance in the rotor causes excentric wear. When the guide vanes of turbines or pumps show too much wear and do not give sufficient tightness, a direct return of the water is caused, water passing from the rotors direct to the inlet port. The pump then gives a diminished output and loses its pressure.

To have new rotors working in worn guide vanes is only half a remedy, since the original tightness is not recovered. It is therefore preferable to rectify the guide vanes very carefully and to fit the corresponding guide plates in the body of the pump in such a fashion that they adjust perfectly to those of the rotor.

Cavitation.—We have indicated earlier in the article a case where a pump works in a turbulent zone. If a molecule of water leaving the rotor is considered it is seen that this molecule is under the control of two forces; on the one hand, centrifugal force is directing it in a line tangential to the rotor, *a c*, Fig. 2, and on the other hand, the outlet velocity in the orifice of the rotor gives it a direction tangential to the curve of the orifice of outlet *a b*. The resultant of these two velocities is indicated on the drawing, Fig. 2, *a d*. It is necessary that the diffuser at its point of origin should be tangential to the direction of this resultant, so that the water enters the diffuser without alteration of flow. The condition is realised on the drawing (Fig. 2). But supposing that the outlet is reduced by half (Fig. 3), the tangential speed *a c* remains

the same; but the outlet speed is cut by half, $a\,b^1$. The resultant of the forces $a\,d^1$ will take a very different direction and will make an angle with the tangent of entry to the diffuser. The liquid flow will leave behind it at the entrance to the diffuser a vacuum and will not retouch the curve of the diffuser until a certain distance from the point of entry. In this vacuum vibration which causes the wear described is produced.

This vibration produces at the same time quite a definite erosion effect in the neighbouring faces, which wears away metal very appreciably after a certain time. This wear seems to be produced by violent oxidation effect. According to the metal in which it occurs it is more or less rapid. In cast iron there is a disintegration

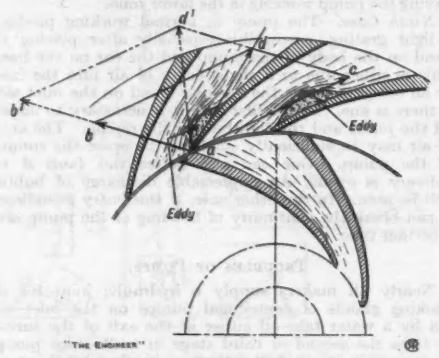


FIG. 5—RUNNING CONDITIONS WITH EXCESS OUTPUT

of the metal by reason of the wearing out of the ferrous molecules and the erosion of the graphitic parts. The aspect is that of blow-holes which amplify themselves and finish by eating into the metal deeply.

In bronze, there is first produced a skinning of the metal which finishes by wearing it more or less regularly, but leaving the worn parts with a surface somewhat softened. It is therefore important in pumps which work at variable speeds and sometimes very much reduced outputs, to have the casings and the diffuser wings of bronze. The effect of cavitation produced by the lower turbulent zone for too weak an output is produced below the point of the diffuser as is shown in the drawing, Fig. 4. As to the upper turbulent zone, if we establish the velocity com-

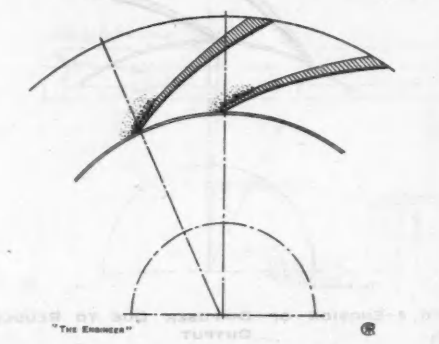


FIG. 6—EROSION OF DIFFUSER DUE TO EXCESS OUTPUT

ponent at the outlet of the turbine, we see that on doubling the output the speed of exit is also doubled, and the resultant makes an angle with the entry curve of the diffuser, $a\,d^1$, but in the opposite sense to the first case—Fig. 5. Irregularities due to this effect of cavitation are produced above the point of the diffuser but bring about the same symptoms—see Fig. 6. For the rest the running conditions of the liquid in a turbine, when they are altered by the imposition of too great an output, or by too great a diminution of the output, produce on the edge of the blades eddies principally upon the angles of the wings and the air casing, and bring about, especially in brass turbines,

FIG. 7—EXTERIOR VIEW OF ROTOR WINGS EATEN BY CAVITATION

characteristic wear—Fig. 7—which can result even in a separation of the end of the wings and of the casing. Bronze turbines, in general, suffer little from the last-named effect.

Technological Achievements.

ON Monday afternoon last, Sir Frank Smith, at a special Jubilee luncheon of the Society of Engineers, delivered a delightful short address on "Some Significant Technological Achievements of the King's Reign."

He said that there were necessarily differences of opinion as to what constituted the principal technical achievements of the King's reign.

"For myself," he continued, "I have only to look at my motor car to appreciate the many directions in which we have advanced during the past twenty-five years. True, there were motor cars in 1910—do we not see some of them in the annual parade of old crocks?—but the car of to-day is made of materials which for the most part did not exist in 1910. The new alloy steels have allowed lighter and yet stronger chassis to be built, new aluminium alloys for pistons have enabled high-speed engines to be produced, non-pinking fuels and the development of anti-detonants, such as tetra-ethyl lead, have allowed higher compressions to be used, coupled with greater efficiency, whilst in the matter of decoration cellulose finishes, non-tarnishable chromium-plating, and pyroxylin fabrics—absolutely unknown in 1910—have added their quota in increasing the quality of the finished product. Those rubber tires have already done 20,000 miles and are good for many more yet, and I remember that in 1910 I used inflation pressures of 60 lb. to 80 lb. with corresponding discomfort in travelling. My wind screen in 1910 was of ordinary glass; to-day, I can get a wind screen of glass which can be bent without breaking and which will bear a load three or four times as great as that needed to break ordinary glass of the same thickness. And should my new wind screen break, it will crumble into crystals suggestive of coarse sugar. A glance at the small ash-tray reminds me that the whole of the plastic resin industry is a development of the last twenty-five years, a development so appreciable that last year in the United States alone the new plastics had replaced steel and non-ferrous alloys in the manufacture of small-sized articles to the extent of 100,000 tons. And my final thought as I turn away from my car is that it is such a wonderful achievement that in this country alone there are over 1½ millions in use."

He proposed, however, to speak, in the main, of four types of achievement. The first was the advances in medicine which had prolonged our lives; the second was the fixation of nitrogen, an achievement which had overthrown the menace to our food supplies resulting from diminishing quantities of Chile nitrate; the third, the production of new steel cutting tools which had largely affected mechanisation, the price of manufactured goods, and the leisure of man; and the last, the more complete harnessing of the electron, an achievement which had given birth to industries unknown in 1910.

"My choice," he said, "of great technical achievements of the King's reign is not quite haphazard. The medical achievements have given us longer life, the mechanical achievements more leisure, the chemical achievements an assured supply of food, and the electron achievements increased amenities of life. Surely we have lived in a reign to be proud of.

"The scientific attack on disease is still in its early stages, but just as engineers give us results in terms of increased life of a motor tire or of a modern boiler, so can those who have made progress in the King's reign in the fight against suffering and disease point proudly to a figure of 6½ years for the average increase in the expectancy of life during the last twenty-five years. Indeed, there are probably tens of thousands of people who saw his Majesty's Jubilee Procession who would have been dead had it not been for the application of knowledge gained in the spheres of medicine and engineering and chemistry. The increase in our span of life has not come about," he continued, "by taking more care of ourselves, but has come without any exertion on our own part through such things as better water supplies, better hygiene, and through increased skill in surgery. Still more marked have been the influence of the biological achievements in the reign such as the discovery of vitamins, which has enabled the Medical Research Council to say in a recent report that 'rickets can now be prevented and cured, and its continuance in our midst is no longer a slur on medical science.'"

FOOD SUPPLIES.

Turning to food supplies, Sir Frank Smith said that in 1910 over 1½ million tons of nitrates from Chile were used each year as agricultural fertilisers. The world demand was then increasing to such an extent that it had been calculated that the Chile nitrates would be exhausted by 1923. There was also the prospect of shortage of ammonium sulphate. To-day, however, more nitrates for fertilisers can be produced from the air above us than we can at present use. The process in brief consists in causing nitrogen and hydrogen to combine together at a temperature of about 400 deg. Cent., at pressures varying from 200 to 1000 atmospheres. To cause the nitrogen and hydrogen to combine rapidly a comparatively small quantity of another substance, called a catalyst, has to be present. What the catalysts really do and how they do it, even at this time, has yet to be discovered, and is one of the unsolved problems of chemistry. Failing definite knowledge, the right substance had to be sought by trial and error, and to bring about the fixation of nitrogen on a satisfactory commercial scale 20,000 different substances were tried out as catalysts.

STEEL CUTTING TOOLS.

Discussing mechanisation, Sir Frank Smith said: "The machine is the basis of our modern civilisation, and steel cutting tools produced in the King's reign have, I think, done more to revolutionise the machine than anything else. In the nineteenth century carbon steel tools could cut steel at the rate of about ¼ lb. a minute. By 1910 the introduction of special alloy steels for cutting tools had increased this rate to 3 lb. per minute.

"During the past twenty-five years progress has been rapid. The tungsten-chromium steels have been produced having a rate of cutting of about 5 lb. per minute; with the addition of cobalt the rate is doubled and the tool retains its hardness and cutting power even when red hot. In 1910 Hadfield's manganese steel was considered for all practical purposes to be non-machinable, grinding being resorted to when accuracy of dimensions was necessary; to-day, it is being machined with ease by the use of this high-speed steel containing cobalt.

"Lastly, we have the carbide tools, which consist of compounds of carbon with tungsten, molybdenum, tantalum or titanium cemented together, as it were, with a matrix of cobalt so that the hardness of the metallic carbides becomes combined with the ductility of a tool steel. With tools of this type the rate of cutting is about 17 lb. per minute, and it is possible to machine glass, porcelain, hardened steel, and chilled iron.

"These new materials were first used as dies for wire drawing. With them the drawing of steel wire becomes a continuous process. Lengths of wires in various stages of reduction can be welded together and run through the dies for weeks and even months without stopping. With the old steel dies the process had to be intermittent because the dies wore out quickly.

"The drawing of steel tubing through carbide dies has also been very successful. To give one striking example; 1,250,000ft. of mild steel tubing of 1¼in. diameter and one-eighth wall thickness has been drawn through one die. When examined the die was still true to size. With the dies previously employed for this particular work, it was only possible to produce about $^1/_{100}$th as much tube per die. I understand that in America there is one tungsten carbide die in use for making screw bases for electric lamps that has been drawing continuously for three years, and when last heard of it had produced no less than forty-seven million screw bases.

"The appreciable increase in the most favourable rate of machining, not less than 5 to 1, together with the increase in the number of materials capable of being machined, has brought about results with which all here will be familiar. Statistics show that in 1933 the production of one car per week occupied only eight persons, whereas fourteen years ago fifty-five were employed. However, the new tools had so cheapened the car that many more were needed, and more people were employed in its production than in 1921; indeed, five times as many.

"So it is in nearly all industries. The new tools have enabled better and cheaper machines to be produced, and these, in turn, have cheapened the production of numerous products from a pin to the machinery of the 'Queen Mary.' True, the progress we have made has produced growing pains, but with sense and good will we shall conquer the pains and not allow them to conquer us."

THE ELECTRON.

Sir Frank then proceeded to deal with the industrial applications arising from the discovery of the electron, and the researches of Sir J. J. Thomson and Lord Rutherford, and others, on the structure of the atom and on matter in general. When a wire filament is heated, he said, in a vacuum, electrons, which could be regarded as negatively charged particles of electricity, can be dragged out of it easily when a positively charged plate is placed near it. This discovery was the basis of the thermionic valve which, in its turn, was the backbone of broadcasting.

"When the King came to the throne there was not one listener-in in the world, for there was no broadcasting station. To-day, in this country alone, there are over seven million people with licensed receivers. There are millions of thermionic valves in use, and on his Jubilee day the King spoke *vid* millions of thermionic valves to hundreds of millions of his subjects. The radio engineer was in charge, and by the simple operation of switches, millions and millions of electrons played the parts arranged for them beforehand. Of all the great technical achievements in history this seems to me to be the most wonderful. However, there are many who think of technical achievements in terms of cash, and these will be interested to know that the turnover in the radio broadcasting industry which did not exist twenty-five years ago was something over 20 millions sterling last year."

Of equal importance industrially has been the discovery that certain substances give off electrons when exposed to light. This discovery has led to the photo-electric cell, and from it the talkie, film as we know it to-day has been developed. There were no talkies before the war, and now there are over 4600 cinemas in this country alone, and about twenty million people in Great Britain visit the cinemas every week. It is not too much to say that in many homes the visit to the talkies is the principal event of the week.

The development of television has also proceeded apace. "It is of interest to note that the minimum service recommended by the Television Committee necessitates the transmission of 1,440,000 signals per second, and after the conversion of these signals into light, the light patches must be arranged in order and synchronised. Such a necessity was realised and scoffed at twenty-five years ago. To-day, the requirement is easily met."

Going back to the heated filament and considering it as a source of light, Sir Frank Smith said that carbon filaments in lamps in 1910 were giving place to the tungsten filaments which gave us more light for our penny. But in 1910 the tungsten lamps were found to be troublesome because of the blackening of the bulb. Research showed that to prevent this traces of water vapour remaining in the bulb had to be eliminated.

"To make the lamp more efficient the filament was raised to a higher temperature, but alas, the tungsten volatilised rather rapidly and deposited itself on the glass, thus once more blackening the bulb. To reduce this effect the vacuum lamp was abolished and an inert gas—argon—was introduced, and thus was born the modern gas-filled lamp, which gives nearly twice as much light for our penny as the vacuum lamp. Tens of millions of these gas-filled lamps are made each year, requiring the separation of argon from thousands of tons of air, the separation being effected by powerful compression liquefying machines. The efficiency of the modern gas-filled lamp is about 15 units per watt, compared with 9 units for the best metal filament lamp when King George came to the throne, so that if our homes were illuminated to-day by the 1910 lamp, and we insisted on having the same intensity of illumination, our annual bill for lighting would be many millions of pounds more than it is; probably not less than 10 millions

"And even this is not the end of the story of the electron, for in the hot cathode discharge tubes used for illuminating some of our main roads, the filament has been abolished and the passage of the electrons through the gases themselves produce the required illumination. The efficiency of these lamps is from 50 units upwards per watt; this is about six times the efficiency of the lamp of twenty-five years ago.

"I suggest to you that one of the greatest achievements of the King's reign has been the harnessing of the electron. It enables one person to speak to and be heard by the whole of the civilised world; it has increased entertainment and amusement through the talkies, and it has enabled our homes, our roads, and our public buildings to be illuminated in a manner which many would have thought impossible twenty-five years ago."

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

The Continental Steel Trade.

Although active conditions have ruled in the British iron and steel market as a result of the limitation imposed upon the importation of foreign steel by the Anglo-Continental steel pact, there has been a noticeable atmosphere of uncertainty. This is due to the protracted and difficult character of the negotiations which are being conducted by representatives of the British and Continental steel works for a Continental quota for the British market and an arrangement covering the export markets. This week fresh meetings have taken place on the Continent, but no decisions appear to have been reached. The absence of export buying has been felt as much by Continental as by British industries, and apparently fears are entertained that if France departs from the gold standard the Cartel may not be able to maintain its fixed prices as it did when the Belgian crisis occurred. Naturally, this has led to consumers adopting an attitude of caution, particularly as reports have been current that in some markets there has been a reappearance of the low prices which Continental works accepted before they reached the temporary understanding with the British. Another factor which is causing some disquiet is the situation of the French internal comptoirs. In several cases the agreements upon which these organisations are founded will expire shortly, and apparently difficulty is being experienced in agreeing upon terms for their renewal. This, of course, constitutes another threat to the control exercised by the Cartel, since the dissolution of any of the comptoirs would probably lead to a breakdown of the price agreements. One effect of the uncertainty as to the fate of the comptoirs has been the decline in the volume of the French home trade. Usually, in times of financial crisis, there is a marked inclination on the part of industrialists to lay in stocks, but this seems to have been absent during the French troubles so far as iron and steel is concerned. Relations between the French and Germans are apparently somewhat strained owing to the latter having entered upon some important barter transactions which have included large tonnages of steel. Against these rather depressing circumstances must be set the fact that the Polish industry is expected to join the Cartel, and has, in fact, become associated with the British and Continental industries in the International Rail Makers' Association (IRMA). Apparently, the only works in Europe now outside this organisation is the Hungarian State Steel Works.

Pig Iron.

The market for foundry pig iron appears to have fallen into a groove, and the situation does not alter much from week to week. This, no doubt, is one of the effects of the producers' policy of maintaining fixed prices, since buyers can see little advantage in booking ahead, excepting in the case of certain brands of which it is known that stocks are low. The latter is the case with Cleveland iron, and the makers are able easily to dispose of their current output. The producers claim that they are fully sold to the end of June, and that good contracts have been booked for delivery in the third and fourth quarters. Only two furnaces are producing Cleveland foundry iron on the North-East Coast; but little has been heard of late of fresh plants starting up, although a short time ago there were expectations that this would take place. The competition of Northamptonshire foundry and some Indian iron is felt in Scotland, where the former is sold at 1s. 3d. less than Cleveland; but North-East Coast makers state that their brands are frequently given a preference against the lower price. In the Midlands business has improved during the past week or two, and it is estimated that consumption now about balances output; but the position is weaker than on the North-East Coast because substantial stocks are being carried by many of the producing firms. Lately, some fair-sized contracts have been entered into and the turnover in May was probably better than for any month since December. Whilst the requirements of the light castings industry appear to be growing, some of the most important users in this branch are not securing sufficient orders to enable them to work full time; but against this can be set the steady demand from the engineering industry. The Scottish makers are experiencing a fair request for their iron, and the stocks at the blast-furnaces are not heavy. The improvement in the position of the light castings industry has been reflected in better deliveries of Scottish foundry iron, notwithstanding that large quantities of English iron are being despatched to Scottish users. The hematite market has become more active, and although the steel makers in the Midlands and Sheffield have been the largest buyers, users in South Wales have also shown greater interest.

The Midlands and South Wales.

Generally speaking, conditions in the Midland markets are satisfactory. The constructional engineers continue to take large tonnages of structural steel, the demand being principally for the heavier sizes. It is possible that the call for this class of material will decline a little for a time, as some of the structural engineering concerns in the Midlands have finished contracts calling for good deliveries of steel. Other firms, however, have important jobs still on hand, which will continue to provide a good outlet for steel. Most of the mills in this district would like to secure more orders for the smaller sizes of angles, bars, &c., but it is considered to be only a question of time before this demand materialises. The plate mills have not received much new business as a result of the Anglo-Continental pact and the difficulty of obtaining Continental material. A fair quantity of medium gauge plates is passing into consumption, but the call for the heavier sizes is distinctly poor, and has been for the past week or two. Business in sheets has shown some improvement of late, although the demand is almost entirely from home users. The majority of the re-rolling firms are well employed, and are making good deliveries. New business in small bars is coming to hand more freely, but the existence of stocks of Continental merchant bars and imports against old contracts held by the merchants acts as a brake upon the development of the demand for home products. The works producing billets have secured a number of good orders lately, and there is a tendency on the part of the makers to lengthen their delivery times. In South Wales the steel works are steadily employed, and contracts which are being worked off are for the most part being replaced. There has been a good demand for billets and the manufacturers of tin-plate bars are in a good position as regards orders. The situation at the tin-plate mills does not alter much, the latest available returns giving the rate of employment as 55·8 per cent. of the allotted capacity.

Scotland and the North.

Until the past fortnight or so the Scottish steel works have maintained a steady level of activity, and the new business coming forward has been in the main sufficient to replace completed contracts. Some irregularity, however, is now apparent in the position. Deliveries continue to be heavy, but some of the works report a decline in the volume of new business. There is no lack of confidence and the outlook is considered good, but apparently many of the constructional engineering firms have finished important contracts and have not secured new work requiring large tonnages of steel. As this comes at a time when the shipbuilding industry is faced with the prospect of quieter conditions, its effect is the more obvious upon the steel trade. A cheerful feature of the position is that there is a good volume of inquiry in the market, whilst the knowledge that the Continental quota has been sold should influence users in the direction of placing orders with home works. The tube mills are running more regularly than for some weeks, notwithstanding that severe competition has been experienced in the export markets since the breakdown of the Continental Tube Cartel. Last week rather more business reached the re-rollers, but there is still a certain amount of broken time in this industry. It is said that the stocks of Continental merchant bars in Scotland remain heavy, and that fresh quantities are still being received against contracts. Business in the heavier gauges of black sheets has been rather brisk, but export trade has been distinctly quiet. In the Lancashire market business has been fairly well maintained, but little of interest has developed. The tendency for buyers to limit their purchases to small tonnages is noticeable, and forward buying of steel materials at the fixed prices is not often indulged in. Lately one or two running contracts have been entered into, but for the most part buyers decline to commit themselves more than three months ahead. The demand for small sections remains steady.

Current Business.

The Vulcan Foundry, Ltd., of Newton-le-Willows, Lancs., has obtained a contract for four locomotives for the Rohilkund and Kumaon Railway of India. A collier of 1300 tons d.w. has been ordered from S. P. Austin and Son, Ltd., of Sunderland, by Wm. France, Fenwick and Co., Ltd., London. The North-Eastern Marine Engineering Company, Ltd., of Sunderland, will supply the engines. William Doxford and Sons, Ltd., Sunderland, have received an order for a motor ship of 9200 tons d.w. The P. and O. liners "Ballarat" and "Mantua" have been sold for scrap, Thos. W. Ward, Ltd., of Sheffield, having bought the former vessel. In future the London, Midland and Scottish Railway Company will use steel for their signal posts in preference to timber. Hatterseley (Ormskirk), Ltd., report that owing to the increase in the costs of manufacture, coupled with the low basis prices which have been ruling for some years past, the prices of all gun-metal fittings will be advanced by 10 per cent. The Sheepbridge Coal and Iron Company, Ltd., Chesterfield, has taken an order for 2000 small wagons from a brickmaking firm. The Department of Overseas Trade reports that the following contracts are open for tender:—Brazil, Rio Grande do Sul State Railways: 21,000 kilos. of sectional steel and about 10,300 kilos. of steel plates for a locomotive furnace (Port Alegre, June 27th); Argentine, State Oilfields Directorate: 46,363 kilos. of black steel sheets, 3810 kilos. of plain galvanised sheets, and small quantities of copper and brass sheets, expanded metal, &c. (Buenos Aires, July 1st); Singapore Municipality: spun cast, cast iron spigot and socket or steel pipes and specials in sizes from 3in. to 12in. diameter (London or Singapore, August 12th); New Zealand Posts and Telegraphs Department: 2000 three-bolt guy clamps (Wellington, August 8th); South African Railways and Harbours Board: seventy-two motor coaches complete, seventy-two complete electrical equipments for same, 144 motor bogie trucks, electrical portions for the seventy-two motor coaches. Alternatively prices are required for seventy-two underframes, thirty-two sets complete electrical equipment for thirty-two trailer coaches, 128 sets complete electrical equipment for 128 trailer coaches without driving ends (South Africa, July 22nd); one 15-ton electrically driven portal jib crane (Johannesburg, July 29th).

Copper and Tin.

The electrolytic copper market has experienced a sharp setback in prices, and although there had been expectations for some time of a normal reaction, the movement took most people by surprise, as it originated in the disturbance caused by the collapse of the N.R.A. in America and the financial crisis in France. There has been a fair amount of buying as prices receded, but the general tendency has been for the volume of business to decrease. The underlying reason for the nervousness displayed by the market is the fear of a breakdown in the producers' agreement to restrict production, as at one time it seemed possible that with the withdrawal of the protection afforded by the N.R.A., the restriction agreement might be held to infringe the Anti-Trust laws of the United States. It might have been expected also that the currency difficulties in France would have resulted in purchases of copper as a hedge, but whilst there was a certain amount of buying, selling by foreign interests predominated. The price of electrolytic dropped back to 7·95 c., or £36 5s. c.i.f., but later became firmer. The restriction scheme which came into force on June 1st should shortly be effectual in limiting the offerings of copper, and should help to strengthen the market. The London standard market experienced a sharp drop in values, and on general selling the decline went further than was anticipated. Nevertheless, the market should recover and be none the worse for a shake-out of weak accounts. . . . The tin market was scarcely affected by the developments in America and France, but so complete is the control exercised by the International Tin Committee that outside events, whatever their effect upon sentiment, have little influence upon the market. One effect, however, of the American developments has been to check buying from that country. This is disappointing, as recently American consumers had shown more inclination to buy than for some months. It is said that the British tin-plate works are using more tin, but, on the whole, it is doubtful if the consumptive demand is increasing to any extent. According to statistics published by Mr. W. H. Gartsen, the visible supply at the end of May was 15,831 tons, a reduction of 456 tons on the previous month.

Lead and Spelter.

A rather irregular tone has ruled in the lead market during the week as a result of the unsettled conditions in other non-ferrous metal departments. Prices at one time receded, but the movement was due almost entirely to the effect of outside events upon sentiment, as there has been little diminution in the industrial demand. The improvement in the position of the lead-consuming trades on the Continent has been maintained, and there has been practically no break in the high level of consumption in this country. It is reported from America that Empire producers and representatives of the American industry have met in New York with the object of reaching some arrangement to avoid uneconomic competition. Whilst some progress was made, no decisions were reached; but it is understood that another meeting has been arranged to take place later in the year. There is still a scarcity of Empire lead in the British markets, and rather high premiums have been asked for prompt metal. Some of the usual supplies of Mexican lead have been sent to the Continent, and some lead has been taken out of warehouse to meet the markets' requirements. . . . The spelter market, in common with other non-ferrous metal markets, was disturbed by the American and French troubles, but recovered more quickly. There is no doubt that the steadiness in the market has been due to the strong demand from consumers, both in this country and on the Continent. As a result of the improvement in the Continental position, less foreign metal has been offered in this country, and there is rather a stringency in the supplies of Empire metal. According to American statistics, the production of spelter during April reached 120,476 tons, compared with 124,613 tons in the previous month.

Non-ferrous Metal Average Prices.

The improvement in the non-ferrous metal markets represented in the official average prices for April continued throughout May, and the averages again show an advance in the prices of all the principal base metals. It is not surprising considering the active conditions which ruled in the copper market last month that the average price for standard cash copper is £2 2s. 4d. higher than the April quotation, whilst the three months average is £2 1s. 11d., and the electrolytic copper price £1 18s. 10d. better. The quotation for wire bars is £1 18s. 3d., and for best selected £1 17s. 10d. higher. The average prices for tin show a moderate increase considering how often wide fluctuations occur in this market. The average price for cash tin in May was £4 2s. 10d. and for three months £1 3s. 3d. better than for the previous month. The strength of the lead market during May was reflected by an increase in the average price for delivery during the current month of £1 12s. 7d., whilst for the third following month it was £1 9s. 7d. better, the mean being £1 11s. 2d. higher. The spelter market also shared in the general improvement, the quotation for the current month showing an advance of £1 12s. 11d. compared with the April average, whilst fo the third following month it was £1 11s. 2d. better, the mean being £1 12s. up. The following are the official average quotations for May issued by the London Metal Exchange:—

Standard Copper	Cash	£33 7	$8\frac{17}{32}$
	3 Months	£33 15	$8\frac{13}{32}$
	Settlement	£33 7	$11\frac{1}{4}$
Electrolytic Copper		£37 0	$8\frac{1}{2}$
Electrolytic Wire Bars		£37 6	$9\frac{3}{4}$
Best Selected Copper		£36 10	10
Standard Tin	Cash	£227 16	$6\frac{3}{4}$
	3 Months	£221 1	3
	Settlement	£227 17	$0\frac{5}{8}$
Lead	For shipment the current month	£13 17	$2\frac{13}{32}$
	For shipment the third following month	£13 18	$9\frac{11}{32}$
	Mean	£13 18	$0\frac{3}{32}$
	Settlement	£13 17	$0\frac{5}{8}$
Spelter	For shipment the current month	£14 10	$8\frac{5}{16}$
	For shipment the third following month	£14 13	$8\frac{7}{32}$
	Mean	£14 12	$2\frac{1}{2}$
	Settlement	£14 10	$9\frac{5}{16}$

Current Prices for Metals and Fuels.

Makers' official home trade prices, per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists 22s. 6d.; plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home. (*D/d Teesside Area*) £ s. d.	Export. £ s. d.
N.E. COAST—		
Hematite Mixed Nos.	3 8 6	3 2 0
No. 1	3 9 0	3 2 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/– rebate*)	3 7 6	—
MIDLANDS—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 11 0	—
„ „ Forge	3 6 6	—
Basic (*Less 5/– rebate*)	3 12 6	—
Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
SCOTLAND—		
Hematite, f.o.t. furnaces	3 11 0	—
No. 1 Foundry, ditto	3 12 6	—
No. 3 Foundry, ditto	3 10 0	—
Basic, d/d (*Less 5/– rebate*)	3 7 6	—
N.W. COAST—		
Hematite Mixed Nos.	3 12 6 d/d Glasgow 4 0 6 „ Sheffield 4 5 6 „ Birmingham	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
LANCS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. YORKS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
MIDLANDS—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	7 10 0 to 8 0 0	—
SCOTLAND—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. COAST—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

	Home. £ s. d.	Export. £ s. d.
LONDON AND THE SOUTH—		
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 6	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
„ under 3in.	8 14 6	7 0 6
Flats, 5in. and under	8 14 6	7 0 0
Plates, ¼in. (basis)	9 0 0	7 15 0
„ ⅜in.	9 5 0	8 0 0
„ ½in.	9 10 0	8 5 0
„ ⅝in.	9 15 0	8 10 0
„ ¾in.	9 10 0	8 5 0
NORTH-EAST COAST—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Plates, ¼in.	8 15 0	7 15 0
„ ⅜in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅝in.	9 10 0	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates, ¼in.	9 5 0	8 5 0
MIDLANDS, AND LEEDS AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 17 6	7 15 0
„ ⅜in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅝in.	9 12 6	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates, ¼in.	9 7 6	7 15 0 to 8 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
GLASGOW AND DISTRICT—		
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 15 0	7 15 0
„ ⅜in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅝in.	9 10 0	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates	9 5 0	8 5 0
SOUTH WALES AREA—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¼in. (basis)	8 17 6	7 15 0
„ ⅜in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅝in.	9 12 6	8 10 0
„ ¾in.	9 10 0	8 5 0

IRELAND—	Belfast. £ s. d.	Rest of Ireland. £ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¼in. (basis)	? 0 0	9 2 6
„ ⅜in.	9 5 0	9 7 6
„ ½in.	9 10 0	9 12 6
„ ⅝in.	9 15 0	9 17 6
„ ¾in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

Sheets.	Home. £ s. d.	Export. £ s. d.
10-G. to 13-G., f.o.r.	9 0 0	8 15 0
14-G. to 20-G., d/d	10 5 0	9 0 0
21-G. to 24-G., d/d	10 10 0	9 5 0
25-G. to 27-G., d/d	11 2 6	9 17 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 0 0
2-ton to 4-ton lots	13 7 6
Under 2 tons	15 0 0

Export: £16 12s. 6d., c.i.f. duty paid India.
„ £11 5s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.

20 by 14 basis, f.o.b. Bristol Channel Ports, 12/2 to 19/2.

Tin-plate Bars, d/d South Wales Works, £5 7s. 6d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 tons	5 15 0
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/–
„ „ 6 p.c. to 8 p.c.	£21 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£21 10 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/–
„ „ „ 1 p.c. carbon	£36 5 0	11/–
„ „ „ 0·70 p.c. carbon	£37 5 0	12/–
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose)	£10 15 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/– p.u.	
„ „ 75 p.c.	£17 17 6 scale 6/– p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	4/6 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Cobalt	5/– to 5/6d. per lb.	

NON-FERROUS METALS.

Official Prices, June 5th.

COPPER—		
Cash	£32 11 3 to £32 12 6	
Three months	£32 17 6 to £32 18 9	
Electrolytic	£36 0 0 to £36 10 0	
Best Selected Ingots, d/d Birmingham	£36 15 0	
Sheets, Hot Rolled	£64 0 0	
	Home.	Export.
Tubes, Solid Drawn (basis)	10d.	10d.
„ Brazed (basis)	10d.	10d.
BRASS—		
Ingots, 70/30, d/d Birmingham	£31 0 0 to £32 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	9¼d.	9¼d.
„ Brazed	11¼d.	11¼d.
TIN—		
Cash	£226 0 0 to £226 10 0	
Three months	£220 10 0 to £220 15 0	
LEAD: Cash and forward	£13 18 9	
SPELTER	£14 0 0 to £14 5 0	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
f.o.b. Grangemouth—Navigation Unscreened	13/– to 13/6
„ Glasgow–Ell	14/6 to 15/6
„ „ Splint	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/– to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—	
Prime Steam	13/6
Unscreened Navigation	12/9 to 13/–
LOTHIANS—	
(f.o.b. Leith)—Hartley Prime	13/6
Secondary Steam	12/–

ENGLAND.

YORKSHIRE, MANCHESTER—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	15/– to 16/–
NORTHUMBERLAND, NEWCASTLE—	
Blyth Best	14/– to 14/3
„ Second	13/3 to 13/6
„ Best Small	10/6 to 11/–
Unscreened	12/6 to 13/6
DURHAM—	
Best Gas	14/6
Foundry Coke	19/– to 20/–

SHEFFIELD—	Inland.
Best Hand-picked Branch	23/– to 25/–
South Yorkshire Best	20/– to 22/–
South Yorkshire Seconds	17/– to 18/6
Rough Slacks	8/– to 9/–
Nutty Slacks	7/– to 8/6

SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Admiralty Large	19/6
Seconds	19/– to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Best Bunker Smalls	13/6 to 14/–
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/– to 26/–
Foundry Coke	24/– to 37/6
Furnace Coke	19/– to 21/6
Patent Fuel	21/–
SWANSEA—	
Anthracite Coals:	
Best Large	36/– to 40/–
Machine-made Cobbles	41/– to 48/6
Nuts	40/– to 48/6
Beans	25/– to 30/–
Peas	19/– to 23/–
Rubbly Culm	11/– to 12/–
Steam Coals:	
Large Ordinary	18/– to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

Manchester prices ½d. per gallon extra.

French Engineering Notes.

(From our own Correspondent in Paris.)

Machinery Exports.

THE value of exports of machinery of all kinds, except electrical, and of engineers' and other tools, reached its peak in 1926, when the franc was devalued by four-fifths, and four years later it began to fall rapidly until, in 1934, the value declined by more than one-half. The tonnage of machinery exported to Great Britain last year was not much more than a quarter of the total for 1930. Figures like these are the cause of serious concern to Monsieur Coville, the general secretary of the Fédération de la Mécanique, in a report he has prepared on the situation of the mechanical engineering industry generally. Apart from the partial closing of foreign markets and the monetary difficulties abroad, he affirms that a primary cause of business contraction is the high cost of production in this country. There is no mention in the report of the far greater drop in value than in tonnage, which implies that manufacturers are making sacrifices that would appear incredible in view of the production costs. Nothing, says Monsieur Coville, has come of attempts to secure State aid for machinery exporters, as is done in the case of motor cars, and he urges that the only solution of the difficulty lies in adopting a definite policy of trade development, first, by organising the production of all ordinary types of machines under cover of adequate protection in order to supply home and Colonial requirements, and, secondly, by profiting from a monopoly of the home and Colonial trade to finance technical research and the creation of laboratories with a view to the construction of special high-class machines for home and export.

The Railway Crisis.

In his address at the Compagnie du Nord meeting, the President, Monsieur Edouard de Rothschild, spoke of the "vertical fall" of railway receipts which had upset the economy and working of the railway, and he saw no salvation except in the rapid co-ordination of all transport systems, which, he said, was proceeding far too slowly on account of the attempts to conciliate conflicting interests. This dangerous situation of the railways has, in fact, contributed largely to the financial difficulties which the country has now to face. The railway deficit of 4000 million francs represents about two-fifths of the total national deficit, although of that amount, the State, it is true, takes three-quarters in the form of taxes and services rendered by the railway companies to the State. Notwithstanding the alleviation of charges imposed by the State on the railways in 1934, and the economies effected by the companies themselves, the deficit was only slightly reduced on account of the heavy fall of receipts. This applies partly to first and second-class passengers, who represented only 2 and 14 per cent. respectively of the total number of passengers carried. The air services are largely responsible for this diminution, and nothing has yet been done to co-ordinate the railways and aviation. The companies fear that the air services will take the cream of the long-distance traffic, and their future is uncertain in view of the dilatoriness with which the problem of enabling the railways to adapt themselves to new conditions of transport is being dealt with, largely because of official efforts to satisfy all interests in spite of the fact that it is impossible to give general satisfaction.

Paris Bridges.

Work is in progress on widening the Pont d'Iéna, which crosses the Seine between the Trocadéro and the Eiffel Tower. On the occasion of the 1900 Exhibition, it was widened by fixing iron brackets at the sides for foot platforms, and that temporary structure remained for about twenty years. The widening for the future exhibition is to be permanent. The work being done is similar to that carried out on the Pont de la Concorde, except that the extensions of the piers on each side are being effected by driving in reinforced concrete piles to water level and enclosing them in a caisson of steel piling filled with concrete, which will be faced with stone. Contracts have been given out for the reconstruction of the Pont du Carrousel, which will have to be completed in a little more than two years, at a cost of 36 million francs. The existing cast iron bridge was built about eighty years ago with stone piers on timber piles. It will be superseded by a new bridge alongside in line with the road traversing the Louvre gardens from the Rue de Rivoli to the Seine. It will be built with three arches, and will have a width of 108ft. The embankments on each side of the river will be widened by encroachments on the lower embankments, and there will be passages underneath the approaches to the bridge to separate the traffic along the embankments from that crossing the bridge. Reinforced concrete will be employed largely in the construction, the whole being faced with stone.

Sound-proof Materials.

The competition organised by the Touring Club de France for sound-proof materials to be used in the construction of walls, floors, and partitions of dwelling-houses will begin at the end of the month by tests of the materials submitted at the laboratory of the Conservatoire National des Arts et Métiers. The conditions of the competition will be available this week, and copies of them can be obtained from the Touring Club de France, 65, Avenue de la Grande Armée, Paris. This test will be followed by another for accessories used in construction with the object of reducing noise. The organisers have also decided to erect a "city of silence" in the Paris Exhibition of 1937, in collaboration with the various industrial associations whose members are interested in the manufacture of sound-proof materials.

The "Dunkerque."

The "Dunkerque" will be floated out of the Salou construction dock at Brest about the middle of September, and as that dock is not long enough to allow of the hull being completed, the battleship will be towed to another dock to be lengthened by about 10 m. It is expected that the trials of the battleship will begin in May next year, so that by the end of that year she is likely to be in service.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., 1s. each.

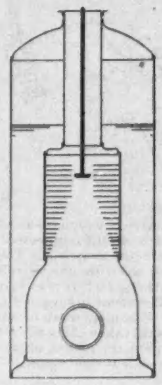
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

427,575. January 12th, 1934.—THIMBLE-TUBE BOILERS, E. F. Spanner, 13, Shooters Hill-road, Blackheath, London, S.E.3.

This boiler is of the familiar thimble-tube or Clarkson type, but is peculiar in that it forms a beehive-like chamber. In this way, the inventor says, the ends of the tubes are made especially effective in the generation of steam, while the remainder of their length is useful in "combing" heat from the products of combustion. His principal claim reads as follows:—Thimble-tube boilers of the type referred to having a multiplicity of rows of horizontal thimble tubes regularly spaced peripherally and vertically, the horizontal and vertical pitches being each approximately twice the diameter of the tubes in the vicinity, successive rows being rotationally displaced about half a pitch, characterised by the fact that approximately half the height of the tube nest measured downward from the top is occupied by rows of tubes which rows are entirely similar to one another, the lower half of the tube nest comprising rows of tubes whose lengths become successively shorter and shorter as progress is made down along the tube nest.—*April 26th*, 1935.

No 427,575



ELECTRICAL APPLIANCES.

427,639. October 27th, 1933.—IRON DUST MAGNET CORES, Standard Telephones and Cables, Ltd., S. E. Buckley, and L. W. Hallett, Connaught House, Aldwych, London, W.C.2.

This invention relates to the manufacture of magnetic dust cores for inductance coils in radio apparatus. The main feature of the invention consists in impregnating the cores after formation with cellulose acetate or a similar substance to provide an insulating skin around the core to increase mechanical strength and lower radio frequency losses. In the production of pressed radio dust core parts great difficulties were experienced in the early stages of development. One trouble was that due to the necessity of employing very fine dust in order to maintain eddy current losses at a low level, the rings were very fragile and easily broken even during ordinary handling. A second difficulty was that the surface layer of the ring is somewhat of the nature of a metallic skin and has a much higher conductivity than the interior of the core; the effect of this outer layer is to increase considerably the core losses at radio frequencies. A process has been evolved according to this invention which produces a much higher resistivity of the outer core layers so that the radio frequency core losses are much reduced, and which at the same time deposits a layer of low loss dielectric upon the core, which dielectric adds enormously to the mechanical strength of the core. As an example, in a dust core in which the insulating material is a phenol formaldehyde condensation product, a solution of cellulose acetate in acetone is applied to the core. The solution penetrates the outer core layers, so that the bakelite between the metal particles is augmented by cellulose acetate, the metal particles being thus forced farther apart so that the outer metallic skin on the core is disintegrated. At the same time the acetone of the cellulose acetate solution which has remained on the outside of the core evaporates, leaving behind a film of cellulose acetate which adheres firmly to the core and thus adds to the mechanical strength. In one method of manufacturing dust cores according to this invention iron dust is used, the particles of which have an average diameter of about 0·005 mm. This dust is mixed with a solution of phenol-formaldehyde condensation product in a solution of alcohol and the mixture is then tumbled to dryness in air and heated in a suitable oven for some hours. The dry mixture thus obtained is pressed into the required shape for the cores or the like at a pressure exceeding 60 tons per square inch. The compressed cores are then baked and finally impregnated in a solution of cellulose acetate in acetone.—*April 29th*, 1935.

TRANSMISSION OF POWER.

427,584. March 19th, 1934.—ELECTRIC CABLES, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2.

The inventors explain at some length how the dielectric properties of oil-filled cables may be spoiled by the production of

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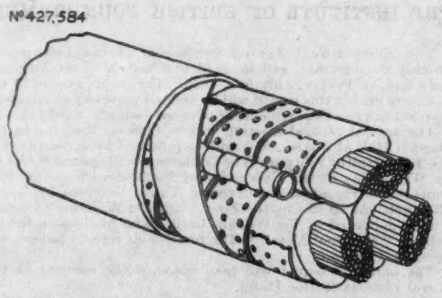

"copper soap," a form of green verdigris, through the action of the oil on copper dust, which may be contained in the cable, in the presence of oxygen, accidentally allowed to enter the cable during installation. As a consequence they carefully clean the copper strands and coat them with tin, which is not affected by the oil.—*April 26th*, 1935.

MEASURING AND TESTING INSTRUMENTS.

427,230. May 23rd, 1934.—ROTARY WATER METERS, E. Sonnek, 20, Hauptstrasse, Weidling, near Vienna, Austria.

This invention is concerned with water meters of the fan or propeller type, which are totally enclosed. These sometimes transmit the revolutions of the fan through a solid cover plate to the counter mechanism by means of electro-magnets. These,

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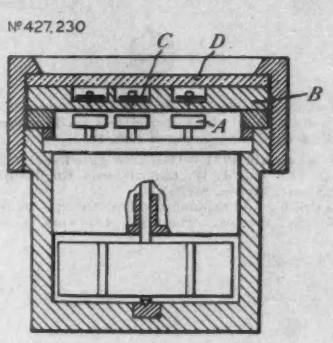

the inventor suggests, are not always reliable, so he provides each counter spindle A with a small bar magnet, and each of these is surmounted on the other side of the brass cover plate B with a magnetic dial C. The whole is enclosed by a glass cover D, which is not subjected to the water pressure. The inventor states that the magnets do not interfere with one another's action.—*April 17th*, 1935.

GAS PRODUCERS.

427,678. April 4th, 1934.—COKE OVEN CHARGING GEAR, G. J. Greenfield, Thorncliffe Coal Distillation, Ltd., both of Thorncliffe, near Sheffield; and Woodall-Duckham (1920), Ltd., Ebury and Allington Houses, 136–150, Victoria-street, London, S.W.1.

In the charging of vertical retort coke ovens it frequently happens that one hopper is empty some time before the others, and in this case the hot gases, which are the products of the decomposition of the coal and which begin to be evolved as soon as the coal enters the oven, rise up into the hopper and thereby constitute a loss of products and, being very hot, the gases frequently catch fire and cause damage to the hopper. It is desirable to enable an operator standing on the top of the oven

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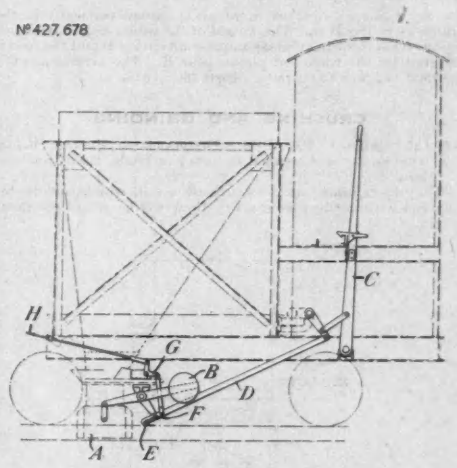


battery to restore any one of the movable sleeves independently of the others to its raised position so that it remains there, to enable him to sweep in any coal which has lodged round the oven charge hole and close the charge hole by means of its lid immediately the coal has all been discharged, without it being necessary for him to go to the driving cab and operate one of the levers. In this design the sleeve A is overbalanced by the weight B and is operated from the hand lever C through the link D. At the end of this link there is a slot E, with a notch at the end to accommodate the pin F of the lifting gear. There is also a linkage G with a handle H conveniently reached from the oven top, by which the link D can be lifted. When this is done the pin F is free and the counterweight lifts the sleeve. It can be reset by the hand lever C.—*April 29th*, 1935.

MACHINE TOOLS AND SHOP APPLIANCES.

427,654. November 14th, 1933.—ROTARY DRILLS, C. M. Escaré, 14, Bardwell-street, North-road, Holloway, London, N.7.

This invention relates to means for preparing holes in walls and the like. The object aimed at is an improved form of drill which will make a hole in any hard substance, such as brick, concrete, cement, tiles, &c., with a minimum of power and without splitting or cracking the surface, for instance, the glaze on tiles. Another object is to replace the usual practice of hammering by a rotational movement of the tool. The drill is preferably

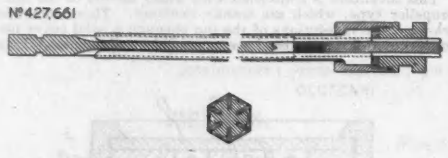
No 427,654

of hardened steel having the usual sharp, tapered, or chamfered drilling end or tip. The end is provided with a longitudinal saw cut on the axial line, extending to a depth of not more than the diameter of the drill. Drills for the purpose required are usually double threaded, giving two chamfered cutting edges, and these edges are provided with one or more V grooves which are formed so as to produce serrated cutting edges. By this means the drill maintains its sharpness for much longer periods of use and entirely avoids cracking the outer surface of the material which is being drilled.—*April 29th*, 1935.

427,661. December 15th, 1933.—THE MANUFACTURE OF TAPERED METAL TUBES, Serk Radiators, Ltd., Warwick-road, Greet, Birmingham; and E. Gardner.

Hexagonal tubes of thin metal are given a slight taper for

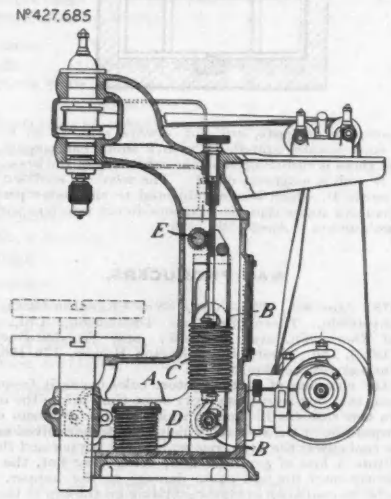
radiator purposes by means of a special mandrel. This mandrel has six longitudinal grooves and in each there is a tapered feather. The mandrel is about twice the length of the feathers.



It is slipped into the parallel tube and drawn through, so that the relative movement of the mandrel and feathers stretches the tube to the desired shape.—*April 29th*, 1935.

427,685. May 29th, 1934.—DRILLING AND TAPPING MACHINES, W. B. Lait and J. W. Lait, Beacon Engineering Works, Hurst-lane, Tipton, Staffs.

In this drilling and tapping machine the spindle is fixed and the work is fed upward to the drill. The work table is carried

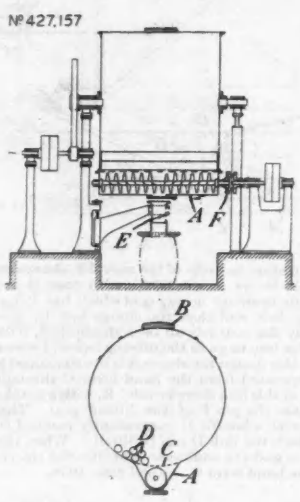


by an L-shaped bracket A, which is guided vertically in the frame by rollers B B. The weight of the table, &c., is balanced by the tension spring C and compression spring D and the feed is effected by the rack and pinion gear E. The arrangement is claimed to promote output.—*April 29th*, 1935.

CRUSHING AND GRINDING.

427,157. August 7th, 1934.—DISCHARGING MIXING MILLS, The Society of Chemical Industry in Basle, Basle, Switzerland.

The object aimed at is to provide a mill which can be discharged without dust nuisance. Along the length of the drum

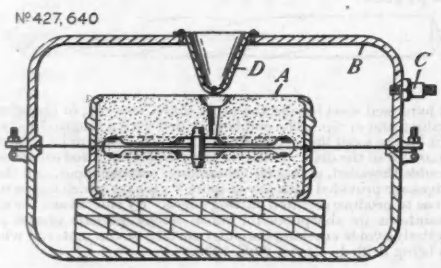


there is attached a double-handed conveyor A, which rotates with the drum. It is counterbalanced at B. Perforations in the drum are provided at C, and roller or ball grinding bodies D may be used. When the batch is to be discharged the door is brought opposite the shoot E, the clutch F engaged and the worm rotated.—*April 16th*, 1935.

METALLURGY.

427,640. October 27th, 1933.—CASTING METALS AND ALLOYS, W. Smithson, Woodolyffe, Summerhill-road, Chislehurst, Kent.

In order to eliminate blow-holes in castings the mould A is

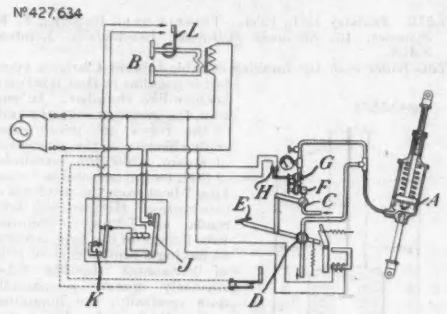


placed in a container B and the space evacuated through the branch C. The molten metal is poured in through the spout D, the bottom of which is sealed, during evacuation, by a fusible plug. The vacuum is maintained until the mould is filled and the spout is then re-sealed for furtheruse.—*April 29th*, 1935.

WELDING.

427,634. October 20th, 1933.—ELECTRIC WELDING MACHINES, New Process Welders, Ltd., Scotts-road, Southall, Middlesex; and F. C. Hohs, 8, The Green, Heaton, Middlesex.

In spot welding it is common to use a pedal to bring the electrodes into contact with the work and to produce the necessary welding pressure, but the operation is fatiguing, so the inventors use a pneumatically worked gear. The pneumatic cylinder for the purpose is shown at A and the electrodes indicated at B. Air for the cylinder is admitted through the valve C and exhausted through the valve D, which are interconnected and operated by a pedal E. The air on its way to the cylinder passes

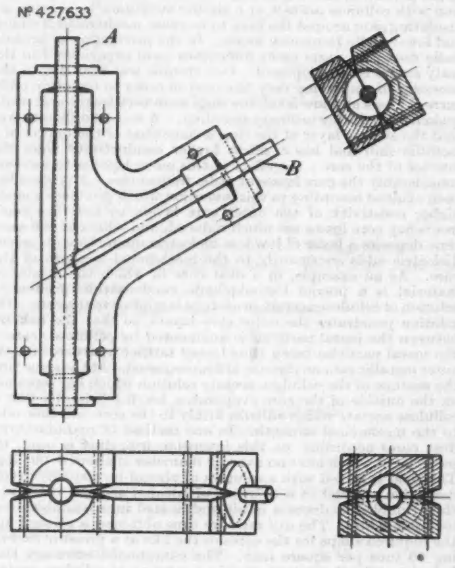


through a reducing valve F and the device G which operates the switch contacts H. This switch is in a circuit connected with the mains and the winding of the contactor switch J. There is also in this circuit the relay K and the electromagnetic relay L. When air is admitted to the cylinder the switch H is closed, the contactor J is consequently closed and current is supplied to the primary of the welding transformer. When the rush of current consequent on the completion of the weld takes place the relay L closes, the relay K is energized, and opens the circuit of the contactor J, so that the welding current is cut off again.—*April 23rd*, 1935.

MISCELLANEOUS.

427,633. October 19th, 1933.—PIPE FITTINGS, Union Minière du Haut Katanga, Elizabethville, Belgian Congo, and 8, Montagne du Parc, Brussels, Belgium.

This specification virtually claims protection for the production of pipe fittings by the electro-deposition of copper. Such fittings are said to be amply strong enough for ordinary service and to be cheaper and lighter than cast fittings. They are made by assembling conductors, such as A and B, in an appropriate



mould and surrounding them with a compound of wax, paraffin, and graphite in the proportions of 1 : 3 : 6, which is conductive of electricity. The mould is then removed, the wax form placed in an electrolytic bath, and a deposit of copper made. If any parts of the fitting require reinforcement the remainder is varnished and the deposition continued. Finally the conductors are removed and the wax melted out.—*April 23rd*, 1935.

THE INSTITUTE OF BRITISH FOUNDRYMEN.

THE thirty-second Annual Conference of the Institute of British Foundrymen will be held at Sheffield from Tuesday, July 2nd, to Friday, July 5th, 1935. The headquarters of the Institute during this period will be at the University of Sheffield, Applied Science Department, St. George's-square, Sheffield.

The annual general meeting will be held on Tuesday in the Mappin Hall at 5 p.m., and will be followed by a reception in the Town Hall at 7.30 p.m. The Conference will open at 9.15 a.m. on Wednesday at the University of Sheffield with a civic welcome. The Presidential Address will then be given by Mr. J. E. Hurst. At 10.45 a.m. the First "Edward Williams" Lecture will be delivered by Sir William Larke, who has chosen for his subject "Man and Metal." Discussions on several papers will open at 11.45 a.m.

The annual banquet will take place in the evening at the Royal Victoria Station Hotel.

The Conference will resume as two sessions on Thursday morning at 9.30 a.m., when Section A will listen to a Symposium on Steel Castings and Kindred Subjects, and Section B will discuss several papers. Afternoon visits have been arranged for both days.

Further particulars may be obtained from the Honorary Conference Secretary, Mr. T. R. Walker, "The Priory," Oughtibridge, near Sheffield.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

PHYSICAL SOC.—At Imperial College of Science and Technology, S.W.7. Council meeting, 4 p.m.; meeting, 4.45 for 5 p.m.

WEDNESDAY, JUNE 12TH.

BRITISH SCIENCE GUILD.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. Annual general meeting. Lecture, "Gas Defence," Mr. J. Davidson Pratt. 4.30 p.m.

WEDNESDAY, JUNE 12TH, TO FRIDAY, JUNE 14TH.

NEWCOMEN SOC.—Summer meeting in Newcastle-on-Tyne. Wednesday: London members leave King's Cross, 10 a.m.; reception at the Municipal Museum of Science and Industry, Town Moor, Newcastle-upon-Tyne, 7.30 p.m. Thursday: Leave Stephenson Hotel at 9.45 a.m. for motor coach tour, calling at Lemington Staiths; Wylam, George Stephenson's birthplace, and other places of interest. Annual dinner, County Hotel, 7 p.m.; reception, Institute of Mining and Mechanical Engineers, Neville Hall; paper, "The Hollow Sword Blade Company and Sword-making at Shotley Bridge," Mr. Rhys Jenkins, 8.15 p.m. Friday: Visit works of R. and W. Hawthorn, Leslie and Co., Ltd., to see the remaining portions of the old South-street works of Messrs. Robert Stephenson and Co., 9.45 a.m.; visit works of C. A. Parsons and Co., Ltd., 2 p.m.

WEDNESDAY, JUNE 19TH.

MANCHESTER ASSOC. OF ENGINEERS.—Visit to works. Joseph Wedgwood and Sons, Ltd., Pottery Works, Etruria, Stoke-on-Trent. Leave Omnibus Station, Lower Mosley-street, Manchester, 12.45 p.m.

SATURDAY, JUNE 22ND.

INST. OF AUTOMOBILE ENGINEERS: GRADUATES' SECTION.—Summer Rally at Burford, Oxon. The President, Mr. L. H. Pomeroy, and Mrs. Pomeroy will hold a reception at the Cotswold Gateway Hotel, Burford, at 3.30 p.m.

MONDAY, JUNE 24TH, TO WEDNESDAY, JUNE 26TH.

INST. OF HEATING AND VENTILATING ENGINEERS.—Summer meeting at Felixstowe. Headquarters, The Felix Hotel. Monday, Council meeting, 5.30 p.m. Tuesday, special meeting of members, 9.45 a.m. Paper, "Fan Characteristics," Mr. W. L. Gee. Reception at Felix Hotel, 6.45 p.m. Banquet and dancing, 7.15 p.m. Wednesday, circular motor drive. Luncheon by invitation of the President, Mr. W. E. Fretwell. Leave Felix Hotel, 10 a.m.

TUESDAY, JUNE 25TH, TO SATURDAY, JUNE 29TH.

BRITISH WATERWORKS ASSOC.—Summer Meeting at Cambridge. For provisional programme see page 382, April 12th.

SATURDAY, JUNE 29TH.

SOC. OF GLASS TECHNOLOGY: LONDON SECTION.—Visit to factory of Frank Cooper, Ltd., Oxford, and the Colleges.

WEDNESDAY, JULY 3RD.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to the works of the Derwent Valley Water Board near Sheffield. Members will depart by motor coach, leaving the White Horse Hotel, Congreve-street, Birmingham, at 8.45 a.m.

THURSDAY, JULY 11TH.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C.2. Conversazione to overseas members.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND CENTRE.—Annual Summer Meeting. Leave Birmingham, New-street, for Liverpool, 8.30 a.m.; visit Mersey Tunnel, Liverpool; luncheon at Hulme Hall, as guests of Messrs. Lever Brothers, 1 p.m.; tour of Port Sunlight works, 2 p.m.; leave for New Brighton, 4.30 p.m. Full particulars from the hon. secretary, Mr. H. Hooper, 54, New-street, Birmingham.

THURSDAY AND FRIDAY, JULY 11TH AND 12TH.

INST. OF MINING ENGINEERS.—Summer meeting at Newcastle-upon-Tyne. Thursday, general meeting at the House of the North of England Institute of Mining and Mechanical Engineers, Neville Hall. The following papers will be submitted for discussion:—"The Grading and Classification of Coal," Mr. H. Eustace Mitton; "Surface Coal Cleaning *versus* Clean Mining," Messrs. George Raw and F. F. Ridley; "Coal and the Marine Engineer," Engineer-Commander Townend; "Cleaning Plant at the Rising Sun Colliery, Wallsend," Mr. Kenelm C. Appleyard. 10 a.m. Luncheon at the Old Assembly Rooms, Westgate-road. 1.30 p.m. Visit the Rescue Station of the Durham and Northumberland Collieries Fire and Rescue Brigade, Elswick. 2.45 p.m. Or alternatively visit the cleaning plant at the Rising Sun Colliery of the Wallsend and Hebburn Coal Company, Ltd. 2.45 p.m. The Institution of Mining Engineers dinner at the Grand Assembly Rooms, Barras Bridge. 7.45 p.m. Friday, leave Neville Hall, 9.30 a.m., for The Chesters, arriving at 10.30 a.m. Luncheon at Otterburn Hall, 1 p.m. Reception and dance, by kind invitation of the Lord Mayor and Corporation of Newcastle-upon-Tyne, at the Grand Assembly Rooms, Barras Bridge. 9 p.m. to 1 a.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ASHMORE, BENSON, PEASE AND CO., Ltd., was incorporated in its present form fifty years ago, and the attainment of the Golden Jubilee is to be celebrated by an excursion to Scarborough with luncheon on Whit Tuesday.

MR. GUY F. DOWDING, A.M.I. Mech. E., has resigned his position as manager of the engineering section at British Industries House, Marble Arch, W.1. Any communications should be addressed to him at 4, Grange-road, Barnes, S.W.13.

THE LIVERPOOL REFRIGERATION COMPANY, Ltd., owing to increased business on the North-East Coast and in Scotland, has opened an office at Pearl Buildings, Northumberland-street, Newcastle-on-Tyne, 1 (telephone No., Newcastle 27,928).

COAL FACE MACHINERY.—After a lapse of four years, the Coal Face Machinery Exhibitors' Association is to hold at the Bingley Hall, Birmingham, from September 20th to 28th, its second exhibition of coal face machinery. On the first occasion the exhibition was held in Sheffield. As on the previous occasion, the Exhibition will not be open to the general public. Admission will be by invitations issued by the Association.